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Reference borrowing: The case of implement terms

Michael Devitt[1] | **Brian Porter**[2]

[1]Department of Philosophy, City University of New York, Graduate Center, New York, New York, USA

[2]The Center for Philosophy of Science, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

Correspondence
Brian Porter, 4200 Fifth Ave., Pittsburgh, PA 15260, USA.
Email: brian.porter@pitt.edu

The article reports experiments testing the theory of reference for implement terms, using "fax machine" and "abacus" as examples. We found strong evidence against the description theory that the reference of these terms is determined by the descriptions that participants associate with them. This supports the causal theory of reference *borrowing* for these terms. We emphasize that our findings do *not* support a causal theory of the initial reference *fixing* by the "experts" who introduce an implement term. Indeed, we think it highly plausible that reference is initially fixed by a description of the implement's function and defining physical characteristics.

KEYWORDS

causal reference borrowing, causal reference fixing, description theory of reference, descriptive reference fixing, descriptive-causal reference borrowing, implement terms

1 | INTRODUCTION

Theories of reference for proper names and so-called "natural" kind terms have been tested often. Theories of implement terms have not.[1] Our aim is to test them, using "abacus" and "fax machine" as our examples. We start with some background on theories of reference.

[1]We prefer to describe the terms we are concerned with as "implement terms" rather than the perhaps more popular "artifact terms", for two reasons. First, although implements are typically artifacts, they need not be artifacts: paperweights can be found on beaches rather than made by us; benches can fall from trees. Second, some artifacts are not implements; for example, some are doodles (Juvshik, 2021); some are not objects at all but stuff, like plastic and vaccines. So, being an artifact is a very different metaphysical category from being an implement. We think that terms that refer to implements, construed generously, form an explanatory semantic category but that terms that refer to artifacts do not.

1.1 | Theories of reference

Until the 1970s, the received view in the theory of reference was that the referent of a term was identified by certain descriptions that competent speakers associated with the term; for example, the referent of the proper name "Aristotle" was determined by its association with a description like "the pupil of Plato and teacher of Alexander the Great"; the reference of the natural kind term "tiger", by a description like "large feline with yellow and black stripes and a white belly". But then came the revolution in the theory of reference, stemming particularly from the works of Kripke (1980) and Putnam (1975). It was argued that this description theory was fundamentally wrong for many terms, including "Aristotle" and "tiger".[2] "Ignorance and error" arguments were particularly influential. People are often too ignorant to supply descriptions that would uniquely identify the referents of their terms. Most of us refer successfully with "elm", but could not come close to describing those trees well enough to distinguish them from other trees like beeches. Speakers can also associate erroneous descriptions with a term; some who use "Einstein" to refer successfully to the famous physicist wrongly think he invented the atomic bomb.

How do people who are ignorant or mistaken nonetheless manage to refer? The revolution proposed an answer, the causal-historical theory. The central idea of this alternative theory was that competent users of a term can *borrow their reference* from earlier users: Underlying current uses are causal chains of reference borrowings in communication situations going back to the original users of the term. We can successfully refer, despite our ignorance of the referent, because we get the benefit of others in our linguistic community who did so before; the determination of reference is a social matter; in Putnam's (1975) neat phrase, there is a "division of linguistic labor" (p. 227).[3] Let us call this theory, *causal borrowing*.

So, the reference of our use of the term is dependent on the reference fixed by original users. But how did *they* manage? We need to supplement causal borrowing with a theory of initial reference fixing. It is hard to say much about fixing, and the founding fathers, Kripke and Putnam, did not say much.[4] For terms like "Aristotle" and "tiger", where the referent has a largely unknown underlying nature ("essence"), we ourselves favor the theory that reference is fixed in that underlying nature by some sort of direct causal-perceptual link between the fixers and the referent, a referential "grounding" that is not mediated by an associated description (Devitt, 1981; Devitt & Sterelny, 1999). Let us call any theory along these lines, causal fixing. However, the alternative, descriptive fixing, always needs to be taken seriously: Maybe the fixers associate certain descriptions with the term which determine its reference. This is certainly true for at least some terms, such as "Jack the Ripper" or "Higgs Boson"—the reference

[2]"The description theory" here means the "classical" theory derived from the works of Frege and Russell, including later modifications in the "cluster" theory. So, we are not considering "circular descriptivism" and the parasitic "causal descriptivism" (Devitt & Sterelny, 1999, pp. 60–61).

[3]The first talk of reference borrowing was by Strawson in proposing his non-classical "cluster" description theory: A speaker borrowed via a description of the lender. This put an epistemic demand on the speaker to identify the lender. Strawson's proposal was brief and only in a note (1959, p. 182n). It seems to have gone unnoticed until Kripke (1980) drew attention to it in proposing his own causal-historical theory of borrowing, with no demand on the speaker to identify the lender (p. 90).

[4]Kripke (1980) talks briefly of "fixing a reference by description, or ostension" (p. 97) and seemed to favor fixing by description (Wettstein, 2012, p. 115). On some theories, fixing by ostension is descriptive too (Reichenbach, 1947; Schiffer, 1978). Putnam (1975) talks of an "ostensive definition", but one accompanied by a description (pp. 225–229): He emphasized later that "descriptions play a key role: The original dubber or dubbers identify or have the capacity to identify what they are talking about by definite descriptions" (2001, pp. 496–497).

can only have been fixed by description, because there was no causal-perceptual link when the reference was fixed.

The distinction between causal borrowing and causal fixing is important in assessing results in experimental semantics. The typical experiment aims to test whether the reference of a term is determined by certain descriptions that competent speakers associate with the term. These experiments often provide direct evidence against the description theory. This anti-descriptivist evidence is then seen as supporting the causal-historical theory. As we shall illustrate, this inference to the best explanation seems to be always appropriate *if* the causal-historical theory is taken to be simply its central idea, causal borrowing. However, experimental semanticists tend to suppose, implicitly if not explicitly, that the causal-historical theory includes causal fixing; they presume that it is a "total" causal-historical theory (Devitt & Sterelny, 1999, pp. 96–100). But there should be no rush to judgment that the anti-descriptivist results that support causal borrowing also support causal fixing.

For, consider the decisively anti-descriptivist results that Devitt and Porot got in their "Gödel-type" test of the proper name, "Tsu Ch'ung Chih" (2018). These results show that the reference of the name is not determined by a description like "the discoverer of the solstices", taken from the vignette, that competent speakers associate with the name. So, we can conclude, by inference to the best explanation, that causal borrowing applies to "Tsu Ch'ung Chih". For, how else can we explain the fact that those speakers successfully refer with the name?[5] But the results do not support causal fixing. They show, of course, that the reference of "Tsu Ch'ung Chih" was not fixed by "the discover of the solstices", but they do not rule out that the reference was fixed by some other description, unmentioned in the vignette. This description might have been associated by the early users of the name, from whom we all ultimately borrow reference, before Tsu Ch'ung Chih became a famous astronomer. So, descriptive fixing may apply to the term. As a consequence, rather than being covered by a total causal-historical theory, the term may be covered by a "hybrid" theory, causal borrowing and descriptive fixing.[6]

So far as we can see, anti-descriptivist results on natural kind terms do tend to support both causal fixing and causal borrowing, hence a total causal-historical theory. Consider, for example, the decisively anti-descriptivist results that we got in testing the biological kind term, "Rio de Janeiro Myrtle" (2024). Those results showed that descriptions of the observable properties of Rio de Janeiro Myrtles are insufficient to identify those trees as the referent of the term. And there are no other descriptions that 19th century biologists could plausibly have used to fix its reference. So, we can conclude, by inference to the best explanation, that causal fixing applies,[7] what about causal borrowing? That is a further inference to the best explanation. The participants, like almost all users of "Rio", obviously have not themselves fixed the reference causally. So, the only way they could be referring is by causal reference borrowing.

In light of this, the distinction between causal borrowing and fixing is important to our experimental project on implement terms. For, our project is to test causal borrowing *but not* to test causal fixing. Indeed, we are inclined to think that descriptive fixing holds for implement

[5]The inference assumes, of course, that no other description theory could give a good explanation of those speakers' reference.

[6]The seminal Machery et al. (2004) led to many other Gödel-type experiments on proper names. Insofar as the results of all these experiments are anti-descriptivist, and not faulty (see Section 1.2 below), they also support only causal borrowing but not fixing. (We think that causal fixing has other support; Devitt, 1981.)

[7]Insofar as the results in the following experiments on natural kind terms are anti-descriptivist, and not faulty (see Section 1.2 below), they would similarly support causal fixing and borrowing: Braisby et al. (1996), Jylkkä et al. (2009), Tobia et al. (2020), Haukioja et al. (2021), and Devitt and Porter (2021).

terms, unlike for many natural kind terms. For, whereas descriptive theories of reference fixing for natural kind terms are highly susceptible to "ignorance and error" arguments, those for implement terms seem not to be susceptible at all. Thus, consider the fixing of "tiger". Even the biologists who did the fixing did not know enough about the historical and underlying nature of tigers to provide descriptions that would be sufficient to identify all and only tigers. Indeed, does anyone? In contrast, this sort of universal ignorance is implausible for implement terms.

For, what is the nature of an implement? First and foremost, an implement has a certain function; thus, the function of a paperweight is to secure loose papers with its weight; the function of a pencil is to write.[8] As Amie Thomasson (2014) argues, an implement's nature may also include a range of specific physical, structural, or perceptible properties that enable it to perform its function, or determine the way in which it is to be used; pens and pencils are both for writing, but are distinguished by physical properties that determine how they write.[9] Now, as Stephen Schwartz (1978, 1980, 1983) and Thomasson (2003, 2007) demonstrate, it is highly implausible that this nature is unknown to everyone, even to reference fixers. Barbara Abbott (1989) points out that implements, unlike natural kinds, are "categorized according to their purposes, so we know how they are shaped and what they are used for ... when it comes time to name them, we have the reference-determining properties at hand" (p. 281). The nature of an implement will be known to those who first make the implement, if it has a maker, and to those who first use the implement. So, it is plausible that they fix the reference of the term for the implement by a description of this nature:[10] descriptive fixing. Finally, it is hard to see how a direct causal link, unmediated by any description, could identify that very nature.

Putnam (1975, pp. 242–243), and others (Kornblith, 1980, 2007; Nelson, 1982; Putnam, 1982) provide ignorance and error arguments for implement terms like "pencil" and "doorstop", which aim to show that universal ignorance and error of the nature of implement kinds is possible, and that therefore the reference of implement and artifact terms must be fixed causally. However, these arguments are flawed (Olivero, 2018; Olivero & Carrara, 2021; Schwartz, 1978; Thomasson, 2003): They show that we may be mistaken in various ways about implements, but they fail to show that all speakers, including inventors and original users who fixed the reference of the terms, can be ignorant about the nature of an implement kind.

Nonetheless, these ignorance and error arguments seem to show that some competent speakers can be ignorant or wrong about the referent of an implement term; for example, we think that it is likely that many competent users of implement terms like "sloop" and "yawl" are too ignorant or wrong to adequately describe their referents. If they are successfully using a term to refer, they must be borrowing reference, ultimately from experts who are not ignorant or mistaken. But perhaps borrowers cannot be totally ignorant about the referent; for example, not knowing that a sloop is a boat. Perhaps the reference of an implement term can only be borrowed if the borrower associates at least some accurate description of the referent; its

[8]Although, see Juvshik (2021) for an argument against function essentialism for artifact terms, including implement terms like "boat" and "chair".

[9]For a discussion of the nature/essence of implements, see Devitt (2023, pp. 72–78).

[10]A noteworthy exception might be terms introduced by archaeologists for ancient implements. The archaeologists may be ignorant of the implement's function, and may even wonder whether the object in question is an implement at all. In such cases, we think that the reference is likely fixed by a physical description, and perhaps by the description that the object has a function, even if that function is unknown. So, descriptive fixing still applies to the term.

borrowing may be covered by a "hybrid" theory of borrowing, descriptive-causal borrowing (Devitt & Sterelny, 1999, pp. 97–98).[11]

In sum, we presume that descriptive fixing is right for implement terms. If so, a total causal-historical theory is not true of them, and the interesting question is whether their reference can be borrowed. We predict that speakers can borrow the references of these terms, and so neither a total causal-historical theory nor a total description theory is true of them. So, we designed experiments on two implement terms, "abacus" and "fax machine", to test this prediction. We aimed to test the description theory against causal borrowing or descriptive-causal borrowing; we did not test fixing.

1.2 | Methodological lessons

In designing the experiments, we took lessons from the past.

(1) We did not follow an early practice of testing a theory of reference against participants' intuitions about what a term referred to (e.g., Genone & Lombrozo, 2012; Jylkkä et al., 2009; Machery et al., 2004). This practice has been extensively criticized by Genoveva Martí (2009, 2012, 2014) and Michael Devitt (2011, 2012a, 2012b). Apart from these objections in principle, tests of referential intuitions have been found to be unreliable in practice.[12] Martí and Devitt urged that theories be tested instead against usage. One effective way to do this is by the method of elicited production. Participants are prompted to produce statements about a situation described in a vignette, thus eliciting the use of a target term that appears in the vignette; the competing theories of reference predict different responses. This is a "pure" test of usage. However, designing satisfactory tests of this sort can be difficult and it was for us here. So, we preferred to test truth value judgments ("TVJ"). In a TVJ test, participants are presented with a vignette including a target term, and asked whether a statement using that term is true or false, or to what extent they agree with the statement. This is a test of usage though a "somewhat imperfect" one because it "puts words into the mouth of the participant" (Devitt & Porot, 2018, p. 1561).

(2) In an important article, Sytsma and Livengood (2011) criticized Machery et al. (2004) on the ground that their probe has an "epistemic ambiguity": Its interpretation depends on "the epistemic perspective that is adopted by participants" (2011, p. 315). When asked who John, the vignette's character, is "talking about" when he "uses the name 'Gödel'", do participants answer from the perspective of the omniscient narrator, as desired, or from that of John, as not desired (p. 319)? This concern about epistemic perspectives is still influential (Li, 2023), but we are dubious about it. For, the probe asks a question that is literally about a worldly referential fact, and not about anyone's opinion of that worldly fact: "If we ask whether it rained at Trump's inaugural, we are not

[11]So, a theory of reference for a term can be hybrid in more than one way. Descriptive-causal borrowing is one way. The earlier-mentioned combination of causal borrowing with descriptive fixing is another way.

[12]Referential intuitions have sometimes been shown to be at odds with tests of usage: Domaneschi et al. (2017) and Devitt and Porot (2018). They have often been shown to be susceptible to disturbing wording effects: Minor changes in the wording of the prompt can have significant impact on the intuitions participants report; Sytsma and Livengood (2011), Sytsma et al. (2015), Machery et al. (2015), and Devitt and Porot (2018).

asking whether Trump, or anyone else, *thinks* it rained" (Devitt & Porot, 2018, p. 1555).[13]

However, we think one version of perspectivalism has turned out to be promising. According to this version, the term "true" in TVJ tests is ambiguous; so, in evaluating the truth of a statement by the vignette's character, "true" may be understood as true from the character's epistemic perspective (Domaneschi & Vignolo, 2020). The ambiguity of "true" has recently been given empirical support by Reuter and Brun (2022). When participants in their experiment were asked to evaluate the truth of a statement made by the vignette's character, some responded according to whether the statement corresponded to reality but some according to whether it cohered with the character's other beliefs. This clearly raises doubts about the value of TVJ tests. However, we do not think such doubts should apply to our TVJ tests, because we did not use "true" in our prompt. Rather, we asked participants to judge which of alternative statements "best describes" what the character, Taylor, is opposed to. But could not there still be a concern because participants may take the prompt to be asking which alternative best describes what Taylor is opposed to *from her perspective*? Perhaps; but this seems a pointless concern, for what Taylor is opposed to from her perspective just is what she is opposed to.[14]

(3) We have argued that many past experiments, including some of ours, have been faulty, yielding contradictory results, because they tested terms that were invented for the experiment (Devitt & Porter, 2021; Genone & Lombrozo, 2012; Jylkkä et al., 2009; Nichols et al., 2016). It is important to test the usage of a term by participants who are linguistically competent with the term, by participants who already have the term in their idiolects. Invented terms will be entirely novel to participants and so their use by participants may not provide good evidence of reference (Devitt & Porter, 2021). So, we chose "abacus" and "fax machine", terms that we supposed would be familiar to participants. We tested for familiarity and included only participants who passed the test.

(4) We conjectured that experiments with vignettes that describe complex, implausible, even fantastical situations, particularly popular "Twin Earth" ones, were likely faulty (Braisby et al., 1996; Experiments 1 and 2 by Tobia et al., 2020; Haukioja et al., 2021). Faced with such a situation, folk participants may do little more than guess at what the term means or how to use it (Devitt & Porter, 2021). Our vignettes describe fairly realistic situations.

(5) A vignette exemplifies linguistic usage, of course. So, when the vignette occurs in an experiment testing a certain theory of reference, it should not exemplify usage that the theory predicts would not occur. For, clearly, any vignette with such usage is biased against that theory. From the start of experimental semantics, many experiments have not been in accord with this principle. Thus, consider a vignette in Machery et al. (2004). This vignette is for an experiment testing the description theory that the reference of "Gödel" is determined by its association with, "the prover of the incompleteness of arithmetic". Among the many uses of the name "Gödel" in the vignette there is at

[13]Devitt (2023) argues that epistemic perspectives, along with cultural variation, are "red herrings in experimental semantics".

[14]However, there may be related issue involving the difference between speaker's reference and semantic reference; we discuss this issue in Section 4.

least one that is inconsistent with what the description theory would predict:[15] "Now suppose that Gödel was not the author of this theorem. A man called 'Schmidt', whose body was found in Vienna under mysterious circumstances many years ago, actually did the work in question" (2004: B6). If the description theory were true, people would not be disposed to say this. People would not, in one and the same breath, both refer to Gödel and suppose away the basis of that reference (Devitt, 2012a, p. 28). Our vignettes contain no such usage.

1.3 | Past experiments

We are aware of only two papers reporting tests of the reference of implement terms. But before we consider those papers, we will briefly comment on the tests of other terms.

Empirical results for proper names have depended on methodology: Tests of participants' referential intuitions have often yielded partly descriptive results,[16] but tests of usage have consistently found evidence of causal borrowing.[17] Empirical tests of the reference of natural kind terms have been less straightforward to interpret, but the picture that emerges is neither purely causal-historical nor purely descriptivist.[18] Our own most recent experiments (2024) confirmed that one theory of reference does not fit all natural kind terms. In particular, using the example of "rice", we found evidence that a biological term referring to something of practical interest to the folk has its reference determined partly by a description of superficial properties and partly by a causal link to an underlying property. "Rice" seems to be covered by a hybrid descriptive-causal theory, both of borrowing and of fixing. In contrast, using the example of "Rio de Janeiro Myrtle", we found evidence that a biological term referring to something of little interest to the folk is covered simply by the causal-historical theory. We turn now to tests of implement terms.

James Genone and Tania Lombrozo (2012) tested both natural kind and implement terms, taking their results to "support a hybrid theory of reference that includes both causal and descriptive factors" (p. 717). We are skeptical of this support because of our methodological concerns (Section 1.2): Their experiments are tests of referential intuitions; they use invented terms; their vignettes include usage that is inconsistent with the predictions of the description theory (Devitt, 2015b, pp. 47–49) and even, on one occasion, of the causal-historical theory (2015b, p. 59, note 23).

Jeske Toorman and Jussi Haukioja (forthcoming) have conducted a series of experiments on terms for tools and games, ingeniously modeled on the Gödel and Jonah ones used by previous experimenters on proper names. What we are calling "implements" are what Toorman and Haukioja call "tools". So their results are very relevant to our project. Given our methodological concerns (Section 1.2), we are particularly interested in the experiments modeled on the TVJ experiments of Devitt and Porot (2018). Devitt and Porot concluded that those experiments counted decisively against the description theory and thus gave indirect support to the

[15]This reflects the fact that the description theory of "Gödel" is so false that it is hard for authors of such a vignette to use the name in a way that does not evidence this falsity!

[16]See especially Machery et al. (2004).

[17]See for example Domaneschi et al. (2017) and Devitt and Porot (2018).

[18]See, for example, Braisby et al. (1996), Genone and Lombrozo (2012), Jylkkä et al. (2009), Nichols et al. (2016), Tobia et al. (2020), Devitt and Porter (2021), and Haukioja et al. (2021), all of which found evidence that participants sometimes use natural kind terms as predicted by the description theory, and sometimes as predicted by the causal-historical theory.

causal-historical theory. (More precisely, given Section 1.1 above, the experiments support causal borrowing.) Toorman and Haukioja obtained almost identical anti-descriptivist results in their analogue experiments on tool and game terms. Yet, they draw a very different conclusion! Instead of concluding that their experiments count against the description and for the causal-historical theory of tool terms, they conclude, in effect, that all experiments on Gödel and Jonah-type cases, whether the earlier ones on proper names or their own on tool and game terms, are faulty: "test subjects' responses to such cases tell us nothing about whether the causal-historical theory is true of *any* term, proper names included". Why this conclusion? Because they have already presumed "that the causal-historical account is not true of [tool and game] terms". So, because their Gödel and Jonah experiments misleadingly imply that account is true of tool and game terms, experiments of these types are altogether faulty.

But why believe the presumption? Toorman and Haukioja offer the following support: "It is at least *prima facie* plausible to think that the causal-historical theory is not true of terms for tools and games, and that the extensions of these terms are rather determined by intended functions and game rules, respectively". This involves a crucial error.

We shall consider tool terms only. Our discussion has already made clear that we also find it plausible that the reference of a tool term is fixed largely, if not entirely, by descriptions of the referent's intended function (Section 1.1). But this could provide no basis for finding these Gödel and Jonah experiments faulty, for the experiments are not testing reference fixing; they are testing reference borrowing. So, what Toorman and Haukioja rightly describe as the "purported causal-historical responses" of those experiments should be taken to support causal borrowing not causal fixing; they are quite consistent with descriptive fixing, as pointed out in Section 1.1 above. We grant that presentations of these results as supporting the causal-historical theory should have been more explicit that the results support only causal borrowing. Still, those are the facts about support. So, Toorman and Haukioja's plausible assumption that the reference fixing of tool terms is descriptive not causal casts no doubt on Gödel and Jonah experiments.

We therefore see the experiments of Toorman and Haukioja as providing powerful support for causal borrowing as a theory of tool/implement terms.[19] We shall see that our experiments provide more support for that theory.

Our experiments are not of the Gödel-type or Jonah-type that Toorman and Haukioja used. That our results are similarly anti-descriptivist to theirs counts against their claim that Gödel-type and Jonah-type experiments are faulty.

But could someone, inspired by Toorman and Haukioja, object that our experiments must be faulty because "it is at least *prima facie* plausible to think that" causal borrowing "is not true of terms for tools and games"? Such a claim would be quite at odds with the ignorance and error arguments from Putnam and others cited above (Section 1.1). We note also that Panu Raatikainen (2020) has recently claimed that "the reference of any sort of term can be borrowed" (p. 77).

Finally, we should mention psychological experiments on "deference". Philosophers often conflate causal borrowing, the theory that a person borrows the reference of a term from a lender's communication, with the theory that a person defers to that lender, often an "expert", when later using the term (Devitt, 2015a, pp. 115–117). So, psychological experiments on

[19]We are, however, a bit dubious of the support provided by the experiments on the invented term, "magnometer". We think that, given the information in the vignette, a canny description theorist might well say that the reference of "magnometer" is fixed by a description along the lines suggested in note 10 above, "objects of physical type X with some as yet unknown function". Toorman and Haukioja's results are consistent with this theory just as they are with causal borrowing.

deference might be thought to be testing causal borrowing. Indeed, Proctor and Keil (2006) present their deference experiments, including some on implement ("artifact") terms, as addressing Putnam's (1975) doctrine of the "division of linguistic labor" for the likes of the term "gold". Yet the concern of these psychological experiments is really with something quite different from Putnam's doctrine. Proctor and Keil consider people who have "intuitive essentialist beliefs about categories" and are required to judge whether something falls into a certain category; for example, to judge whether it is gold. The psychological experiments are then concerned with the circumstances in which these people "should defer to those experts who know a category's essence" in making their judgments (2006, p. 1974). So, this concern is with how epistemic deference to experts explains a person's judgments about the world. In contrast, Putnam's concern is with how semantic deference to—better, reference borrowing from—other people explains a person's reference with a term.

How might evidence of epistemic deference to experts bear on causal borrowing? Only if that evidence shows that the description theory is wrong. For, consider how epistemic deference gets into the borrowing story. We have noted (Section 1.1) that if results show that reference is not determined by associated descriptions and so the description theory is false, then, by inference to the best explanation, causal borrowing. Furthermore, if causal borrowing, then participants should defer to experts in identifying the objects referred to. So, in brief, if not description theory, then epistemic deference. But, importantly, there is no claim that if epistemic deference then not description theory; indeed, that seems baseless. A consequence of this is that evidence of epistemic deference in psychological experiments is evidence of causal borrowing only if it is evidence against the description theory.

Given that Proctor and Keil (2006) did not aim to test the description theory of implement terms it would have been surprising if their experiments had produced evidence against that theory. In any event, we find no such evidence. Nor do we in other works testing "psychological essentialism" (e.g., Kalish, 2002; Malt, 1990). In sum, experiments on epistemic deference do not inform us about reference borrowing.

1.4 | Our aims

We aimed to test the reference borrowing of two implement terms: "abacus" and "fax machine". These terms refer to manmade implements, with clear functional and physical properties that constitute the nature of the kind. An abacus is an implement for calculating by moving beads along wires. A fax machine is an implement for sending and receiving electronic copies of pages or images through telephone lines. The terms refer to all and only things that fulfil those functions via those physical properties: A calculator that does not include beads on a wire is not an abacus; a system that scans and emails a document from one location to another is not a fax machine. So, according to the description theory, the term "abacus" or "fax machine" must refer in virtue of competent speakers associating the term with descriptions of the just-specified functional and physical nature of the term's referent. If speakers succeed in referring despite not associating those descriptions, then the description theory is false. If a speaker can refer despite failing to associate any of those descriptions, then causal borrowing must be true of the term. If she can refer despite failing to associate some but not all of those descriptions, then descriptive-causal borrowing must be true of the term.

To test this, we provided participants with vignettes: some in which a speaker is too ignorant about the nature of fax machines/abacuses to associate reference-determining descriptions;

some in which the speaker is too mistaken to associate such descriptions; and some in which the speaker associates a true description with the terms. We split our ignorance and error conditions into three versions: one in which the speaker is ignorant or mistaken only about the functional properties of the implement; one in which the speaker is ignorant or mistaken only about the physical properties of the implement; and one in which the speaker is ignorant or mistaken about both functional and physical properties. If we find that participant responses indicate that the speaker successfully refers even when completely ignorant or mistaken about the implement in question, that will provide evidence against the description theory and for causal borrowing. If we find that the speaker successfully refers only when they associate a true description of the functional properties then that will provide evidence against the description theory and for one version of descriptive-causal borrowing; if only when they associate a true description of the physical properties, another version of descriptive-causal borrowing. If we find that the speaker does not refer successfully even when they associate a true description of both functional and physical properties, then the test is faulty. We planned to use these responses as a baseline; if responses indicate that the speaker refers successfully at roughly equal rates given a true description and given some form of ignorance or error, that is, evidence that form of ignorance or error does not impact a speaker's ability to refer with an implement term.

2 | METHODS

Four hundred and forty-eight participants were recruited via CloudResearch Connect, and were compensated for their participation. Data was collected using the online survey platform Qualtrics. Participants were randomly assigned to one of two implement terms: either "abacus" or "fax machine".

2.1 | Familiarity questions

After answering a mandatory generic attention check question, participants were asked four binary true/false questions, to test their familiarity with the term to which they were assigned. For example, the questions for "fax machine" are below:

Fax machines are small office machines with a paper tray

- True
- False

Fax machines send documents through the phone line

- True
- False

Fax machines are handheld machines with a touchscreen and a camera

- True
- False

Fax machines will send a digital copy of a document to your computer

- True
- False

All four questions were presented to participants on the same page; the order of the questions was randomized. Participants were deemed to have passed the familiarity check if at least three of their four answers were right.

2.2 | Vignettes

After answering the familiarity questions, participants were presented with a vignette featuring the implement term to which they were assigned. Each vignette features a character, Taylor, who either (a) associates a true description with the implement, (b) is ignorant about the function and/or physical properties of the implement, or (c) is mistaken about the functional and/or physical properties of the implement. For example, the fax vignette is below:

> Taylor is a young college student. One day, Taylor sees some of the other students sitting at a table in the lunchroom with a ballot box. They tell Taylor that there is a campus-wide poll about removing all of the fax machines in the library. Taylor is outraged to hear this, and says: "That's a terrible idea!" The other students scoff, suspecting that Taylor must be confused about fax machines. Taylor responds: "Well, it is true that I don't know much about fax machines. I've never used one myself. But I have heard my parents talking about them. [SUBSTITUTION] But the key thing is that I've heard fax machines are very useful. So, I am opposed to the library removing its fax machines."[20]

Participants were assigned to one of seven conditions, with a different substitution for each condition: True description, Ignorance physical, Ignorance functional, Ignorance both, Error physical, Error functional, and Error both. The substitutions for "fax machine" are below:

True description: I know that they are small office machines with a paper tray. They can be used to send documents through the phone line, without needing a computer or internet access.

Ignorance physical: I don't know what they look like, but I do know they can be used to send documents through the phone line, without needing a computer or internet access.

Ignorance functional: I don't know what they are for, but I do know that they are small office machines with a paper tray.

Ignorance both: I don't know what they look like or what they are for.

Error physical: I know that they are handheld machines with a touchscreen and a camera that can be used to send documents through the phone line, without needing a computer or internet access.

[20]Our vignettes were partly inspired by those of Wesley Buckwalter, Kate Devitt, and Michael Devitt in experiments described in Devitt (2015b, pp. 49–53).

Error functional: I know that they are small office machines with a paper tray. If you put a document in the tray the machine will scan the document and send a digital copy to your computer.

Error both: I know that they are handheld machines with a touchscreen and a camera. If you photograph a document the machine will send a digital copy to your computer.

2.3 | Prompts

Participants were then presented with the following forced-choice prompt:

> Please answer the following question, taking the question and the answer choices as literally as possible. This is not a trick question; just choose the answer you think is correct.
> In general, Taylor is clearly opposed to removing devices that are very useful. Now set that aside and consider what in particular Taylor is opposed to in the situation described. Which of the following best describes what Taylor is opposed to the library removing?
>
> ◦ Fax machines
> ◦ Not fax machines, but something else (or nothing at all)
> ◦ It is not clear what in particular Taylor is opposed to removing

This was followed by the request:

Please explain your answer to the previous question. Give reasons, but be brief.

2.4 | Content check question

On a separate page, participants were then asked a content-based comprehension question, as in Tobia et al. (2020) and Devitt and Porter (2024). The content-based comprehension question for "fax machine" is below:

> Taylor had quite a bit to say about fax machines. Which one of the following most accurately describes some of what Taylor said?
>
> ◦ Taylor said "they are handheld devices with a touch screen and a camera"
> ◦ Taylor said "they are small office machines with a paper tray"
> ◦ Taylor said "I don't know what they look like"

Participants were deemed to have passed the content-based check if their answer matched the substitution that they saw in the vignette. Participants were not able to go back to the previous page with the vignette.

Participants then answered demographics questions.

3 | RESULTS

Of the 448 participants recruited, 398 passed both the generic attention check and the content-based comprehension check. Three hundred and forty-nine of those participants passed at least three familiarity questions, and were included in the study.[21]

Results for the main prompt can be found in Table 1. "Fax machines"/"Abacuses" responses, indicating that Taylor successfully refers, are coded SR; "Not fax machines/abacuses, but something else (or nothing at all)" responses, indicating that Taylor fails to refer, are coded FR; "It's not clear what in particular Taylor is opposed to removing", indicating that participants are unsure whether or not Taylor successfully refers, are coded U.

As Table 1 reveals, we had high rates of SR responses not only in true description conditions, which all theories predict if the test is good, but in all conditions. This indicates that participants take Taylor to refer successfully with "fax machine" and "abacus" despite ignorance and error. This is contrary to the predictions of the description theory and even to those of descriptive-causal borrowing.

Table 2 presents comparisons between terms and conditions using two-sided Fisher's exact tests. We find no significant differences in response rates for the terms "abacus" and "fax machine". Responses in the ignorance conditions are indistinguishable from responses in the True description condition, but those in error conditions are significantly lower than in the True description ($p = .0007$) and ignorance ($p < .0001$) conditions. There were no significant differences in responses between physical ignorance/error and functional ignorance/error, or

TABLE 1 Participant responses to the main prompt in each condition.

Term	Substitution	*N*	SR responses (%)	FR responses (%)	U responses (%)
Fax machine	True description	24	95.8	4.2	0
Fax machine	Ignorance physical	23	95.	4.3	0
Fax machine	Ignorance functional	26	92.3	7.	0
Fax machine	Ignorance both	28	96.4	0	3.6
Fax machine	Error physical	22	68.2	22.7	9.1
Fax machine	Error functional	26	80.8	11.5	7.7
Fax machine	Error both	27	63	25.9	11.1
Abacus	True description	24	95.8	0	4.2
Abacus	Ignorance physical	24	95.8	4.2	0
Abacus	Ignorance functional	26	88.5	11.5	0
Abacus	Ignorance both	24	95.8	4.2	0
Abacus	Error physical	25	72	24	4
Abacus	Error functional	27	88.9	7.4	3.7
Abacus	Error both	23	73.9	21.7	4.3

[21]Two hundred and twenty-three participants passed all four familiarity questions; there are no statistically significant differences in results between the 349 who passed three familiarity questions and the 223 who passed all four familiarity questions.

TABLE 2 Comparisons between conditions.

Comparison	*N*	*p*	df
Abacus versus fax machine[a,b]	349	.5634	2
True description versus ignorance[a,c]	199	.4403	2
True description versus error[a,c]	198	.0027*	2
Ignorance versus error[a,c]	301	<.0001*	2
Physical ignorance/error versus functional ignorance/error[b,c]	199	.6392	2
Physical or functional ignorance/error versus both ignorance/error[b,c]	301	.6350	2

Note: This table compares response rates between conditions across all three response categories. All *p*-values are calculated using two-sided Fisher's exact test, with the Freeman–Halton extension for 2 × 3 contingency tables.
[a]Combines results for physical/functional conditions.
[b]Combines results for ignorance/error conditions.
[c]Combines results for fax/abacus terms.
*Significant at $p < .05$.

TABLE 3 SR versus FR: Comparisons to 50% chance.

Condition	*N*	*p*	Odds ratio	df
True description	48	<.0001*	46.08	1
Ignorance	150	<.0001*	17.76	1
Error	140	<.0001*	4.00	1

Note: This table compares the ratio of SR and FR responses to random chance, combining results for both "abacus" and "fax machine" and aggregating all ignorance conditions and all error conditions. All *p*-values are calculated using a two-sided Fisher's exact test with a 2 × 2 contingency table.
*Significant at $p < .05$.

between ignorance/error about both physical and functional properties versus ignorance/error about just one kind of property. All data, as well as regression analyses, are available in an OSF repository: https://osf.io/pzhwm/files/osfstorage.

We would like to compare the rates of SR and FR responses to random chance. The rate of SR responses is statistically significantly independent from chance (33%) in all conditions, but this is partly attributable to the low rate of U responses, which in many conditions is 0%. This would result in response rates significantly greater than 33% in one or both other categories, regardless of how rates of SR and FR responses compared to each other.

To get a more informative comparison, we exclude U responses, and compare the rates of SR responses to 50% chance *among participants who gave an SR or FR response*. The results can be found in Table 3. We aggregate the physical/functional/both conditions for ignorance and for error, as we found no significant differences between the different kinds of ignorance/error. We find that even in error conditions, where SR responses are significantly lower than in the True description condition, SR responses are significantly higher than chance ($p < .000001$).

4 | DISCUSSION

The high rate of SR responses, and the very low rate of FR responses, across all conditions, is evidence against the description theory of implement terms: Participants overwhelmingly indicate

that Taylor, the speaker in the vignette, successfully refers to fax machines and abacuses even when Taylor is too ignorant or mistaken to associate the true descriptions of the implement that, according to the description theory, should determine the reference of the implement term. So, we reject the description theory as it applies to these terms. And, by inference to the best explanation, we conclude that Taylor must be borrowing reference from other speakers.

However, there is still a question of which theory of reference borrowing applies to these implement terms: Pure causal borrowing or the hybrid descriptive-causal borrowing? The latter will apply if reference succeeds except when Taylor fails to associate *just one particular part* of the identifying description. Previous results with "rice", described in Section 1.3, implied that descriptive-causal borrowing applied to natural kind terms that are of high practical interest. Given that implements are inherently of practical interest, we had thought that descriptive-causal borrowing was quite likely. However, our results count against it.[22]

Consider Ignorance physical, 95.7% of participants took Taylor to refer to fax machines despite Taylor's ignorance of their physical properties; in the case of abacuses the results were 95.8%. The results for Ignorance functional are similarly decisive. The results are not so decisive with Error physical and Error functional, but they are decisive enough, particularly given our explanation below of the difference between the ignorance and error results. In sum, our results support causal borrowing not descriptive-causal borrowing.

Although the proportions of FR responses in the error conditions were small, they were statistically significantly higher than in the ignorance conditions. Why? We conjecture that, despite our instructions about taking "the question and the answer choices as literally as possible", a few participants in the error conditions responded not to what they took Taylor to have literally said, but rather to what they took Taylor to really mean.

In the error condition vignettes, Taylor attributes some property to fax machines/abacuses that those implements do not in fact have. Many participants will know that other things, such as scanners or slide rules, really have that property. We conjecture that a few of those participants suppose that Taylor is *confused about the nature of fax machines or abacuses*, taking them to have the properties of another implement. So although Taylor *says*, for example, "I am opposed to the library removing its fax machines", those participants suppose that what Taylor really *intends* to oppose is the removal of scanners or smart phones. In Gricean terminology, though Taylor's utterance *semantically refers* to fax machines, Taylor *speaker-refers* to those other things. This explains the small yet significant increase in FR responses in the error conditions: Nearly all participants take Taylor to *semantically* refer to fax machines or abacuses, but a small number of them respond instead with regard to what Taylor *intends* to oppose, rather than to what Taylor literally referred to when voicing opposition. This conjecture is supported by some of the explanations given by participants who provided FR responses in the error conditions. For example:

- "I think Taylor is opposed to removing printers from the library but is confusing them for fax machines."
- "Taylor seems to have fax machines confused with something else probably so-called smart phones. It is unclear to me whether Taylor would really be opposed to fax machines being removed from the library if he actually knew what a fax machine was."

[22]Though, we should note, the results count only against a descriptive-causal borrowing that requires an associated description of the functional or physical properties specified in the vignettes. The results do not count against one that requires, say, the association of a very general description like "implement".

- "Taylor says that they believe the abacus is a long ruler type toy however that is not correct. They are made of beads and wires therefore, Taylor is opposed to the school abacus."

Finally, note that our explanation does not predict a similar number of FR responses in the ignorance conditions because, in those conditions, Taylor gives no sign of confusing abacuses or fax machines with other things. Hence the difference between ignorance and error conditions.

5 | CONCLUSION

According to the description theory, the referent of a term is determined by certain descriptions that competent speakers associate with it. To successfully refer using an implement term, this will require that the speaker associates with the term a description of the referent's function and, probably, the specific physical, structural, or perceptible properties that enable it to perform its function. We tested this theory on the implement terms "fax machine" and "abacus", using the method of truth value judgments. Our experimental results counted decisively against the description theory: Participants took Taylor, a character in vignettes, to refer successfully with these terms in a range of conditions in which Taylor was ignorant or wrong about the function and/or the physical properties in question. We conclude, by inference to the best explanation, that Taylor must be borrowing the reference of these terms. Our results are inconsistent even with the hybrid theory, descriptive-causal borrowing. We therefore conclude that the causal borrowing theory applies to these implement terms.[23]

According to causal borrowing, underlying current uses of a term are causal chains of reference borrowings in communication situations that go back to the original users of the term. Taylor can successfully refer using "abacus" or "fax machine", despite being ignorant of or mistaken about the referent, because Taylor gets the benefit of others in the linguistic community who have successfully referred with the term before, including the original users of the term.

This leaves open the question of how those original users managed. How did they fix its referent in the first place? According to causal fixing, the referent is fixed by some sort of direct causal relation between the fixers and the referent. According to descriptive fixing, the referent is fixed by descriptions that the original users associate with it. We emphasize that though our experimental results support causal borrowing, they do not provide evidence for or against causal fixing, and so do not support a "total" causal-historical theory that includes both causal borrowing and causal fixing. Indeed, we favor the idea that implement terms are covered by descriptive fixing.

If we are right and even implement terms can be borrowed, then one wonders whether all terms can be borrowed. Perhaps a "total" description theory is not true of any term.

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[23]But see the qualification in note 22. Also, of course, it remains to be seen if this conclusion generalizes to all implement terms. For example, does it apply to copywritten implement terms like "iPhone"? We predict that it does; but perhaps competent users of "iPhone" have to associate it with "made by Apple", resulting in a version of descriptive-causal borrowing.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Michael Devitt https://orcid.org/0000-0003-2298-2490
Brian Porter https://orcid.org/0000-0002-6185-4072

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