Existence Hedges, Neutral Free Logic and Truth

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Abstract

Semantic externalism in the style of McDowell and Evans faces a puzzle formulated by Pryor: to explain that a sentence such as 'Jack exists' is only a posteriori knowable, despite being logically entailed by the seemingly logical truth 'Jack is self-identical', and hence being itself a logical truth and therefore a priori knowable. Free logics can dissolve the puzzle. Moreover, Pryor has argued that the existentially hedged 'If Jack exists, then Jack is self-identical', when properly formalised, is a logical truth in a system of neutral free logic and therefore a priori knowable, while it does not entail that Jack exists. The latter holds also for negative free logic. In response, Yeakel has argued that on any system of neutral free logic existence hedges will either entail some unwanted existence claims or they will not entail some wanted existence claims. The dilemma also holds for any non-positive free logic. It will be shown that the extension of one of the systems of neutral free logic with a truth operator escapes Yeakel's dilemma, whereas no other non-positive free logic when extended with the truth operator does the same (or it breaks quantifier exchangeability).

Keywords semantic externalism; existence hedges; neutral free logic; truth

1 A Puzzle for Semantic Externalism, Free Logic and Existence Hedges

The background of the discussion is a certain puzzle for *semantic externalism*. Consider the following two sentences:[1]

(E) Jack exists.

(I) Jack is self-identical.

According to semantic externalists such as McDowell (1977, 1984, 1986) and Evans (1981, 1982), the thoughts expressed by (E) and (I) are 'object-dependent':

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[1] I will use the same labels for sentences and their formalisations as Yeakel (2016) does.

to have the thoughts expressed by (E) and (I) there must be an object denoted by the proper name 'Jack'. This makes (E) and (I) 'hyper-reliable' according to Pryor (2006a, p. 328): to entertain the thoughts expressed by (E) and (I) means that they are true. But, so Pryor maintains, (E) is naturally taken to be knowable only a posteriori, despite being hyper-reliable according semantic externalism. For Pryor (2006a, p. 327), '*in* or *by* rehearsing a sentence to yourself', you occurently have a '(most specific) type of thought'. However, now there is a puzzle (Pryor, 2006a, p. 335). It seems that (I) is a priori knowable, because it seems to be a logical truth. Moreover, (I) seems to entail (E). But then it would seem that (E) is also a logical truth and on that basis it would also seem to be a priori knowable. In what follows, we will focus on the sentences, not on the thoughts expressed by the sentences.

In classical logic (I) and (E) are logical truths (when properly formalised) and, hence, (I) entails (E). Defenders of classical logic then only have the option of denying that logical truths are a priori knowable or accepting that (E) is indeed a priori knowable. Are there non-classical logics that one can use for denying that (I) or (E) are logical truths or that (I) entails (E)? In *free logics*, (E) is not a logical truth, so that is no basis for it being a priori. There are three types of free logic (Nolt, 2020). In negative free logic, an atomic sentence is true only if all the terms occurring in that sentence denote something. In positive free logic, an atomic sentence can be true even if one or more of the terms occurring in it do not denote something. Both negative and positive free logic are bivalent: sentences are true or false. In neutral free logic, an atomic sentence is neither true nor false if at least one of the terms occurring in it does not denote anything. In negative free logic and neutral free logic, the truth of (I) does entail the truth of (E). However, in those same systems, neither (I) nor (E) is a logical truth, so that is no ground for them being a priori. In positive free logic, (I) is a logical truth, but (E) is not, so there the truth of (I) does also not entail the truth of (E). Pryor (2006a, pp. 336-337) himself solves the puzzle by opting for *neutral free logic*.[2]

In addition to opting for a neutral free logic, Pryor (2006a, p. 337) points out that *existence hedges* are useful in this context.[3] By making (I) conditional on the existence of Jack, on obtains a version of (I) that is hedged against the non-existence of Jack:

[2]Pryor (2006b, section XI) discusses to what extent his logic of sentences can be translated into a logic of thoughts.

[3]In his discussion of a priori knowable contingent truths, Kripke (1980, pp. 54–56) first uses an example without an existence hedge (viz. 'stick S is one metre long at t_0'), but later Kripke (1980, p. 79, fn. 33) uses an example with an existence hedge ('if such and such perturbations are caused by a planet [which is a priori equivalent to 'Neptune exists'], they are caused by Neptune'). Evans (1979, p. 170–172) discussed another existentially hedged example of an a priori knowable contingent truth (viz. 'if anyone uniquely invited the zip, Julius invented the zip'), and he noted that the background logic cannot be classical logic but instead has to be a free logic: in classical logic 'Julius' has to denote something, regardless of the hedging condition, whereas this is not required in free logic. Pryor (2006a, p. 339) remarks that, if the hedged claim is still 'object-dependent' according to Evans (which it is if the background logic is classical) and if the hedged claim is supposed to be a priori, then so is the relevant existence claim.

(H) If Jack exists, then Jack is self-identical.

Unlike (I), (H), when properly formalised, is a logical truth in Pryor's system of neutral free logic and, hence, it is a priori knowable (Pryor, 2006a, p. 338). Unlike (I), (H) does not entail (E). In negative free logic (H) is also a logical truth and it also does not entail (E). So, if one uses a non-positive free logic, then the existentially hedged self-identity statement (H) is a related a priori knowable truth that may be accepted without reinstating the puzzle. (If one uses positive free logic, then the existentially hedged self-identity statement (H) is also a logical truth, but so is the non-hedged self-identity statement (I), which also does not entail (E), so the existence hedge is then not so useful.)

In section 2 a brief exposition on the various systems of neutral free logic will be offered. Next, in section 3 I will first summarise Pryor's approach to existence hedges based on neutral free logic. Moreover, I will state and explain Yeakel's dilemma, namely that on any system of neutral free logic existence hedges will either entail some unwanted existence claims or they will not entail some wanted existence claims. This will be combined with an observation by Pryor that in effect generalises Yeakel's dilemma to any non-positive free logic. In section 4 I will propose an extension of one of the systems of neutral free logic and I will argue that it can adequately deal with existence hedges.

2 Neutral Free Logic

The logical system proposed by Pryor (2006a) is a *free* logic, because terms can fail to denote, and it is a *neutral* free logic, because atomic sentences that contain a non-denoting term are neither true nor false. One could say that they have the neutrality value (n) rather than the truth value (1) or the falsity value (0). There are many different systems of neutral free logic, depending on

- one chooses weak Kleene (table 1) or strong Kleene truth tables (table 2)
- one chooses trivalent or bivalent rules for the quantifiers.

Table 1: Weak Kleene

$\wedge$	1	n	0
1	1	n	0
n	n	n	n
0	0	n	0

$\vee$	1	n	0
1	1	n	1
n	n	n	n
0	1	n	0

$\rightarrow$	1	n	0
1	1	n	0
n	n	n	n
0	1	n	1

$\neg$	
1	0
n	n
0	1

If one opts for bivalent rules for the quantifiers, then there two further options. Lehmann (1994) stipulates that

- $\forall x\phi$ is false if ϕ is false of something, otherwise it is true

Table 2: Strong Kleene

$\wedge$	1	n	0
1	1	n	0
n	n	n	0
0	0	0	0

$\vee$	1	n	0
1	1	1	1
n	1	n	n
0	1	n	0

$\rightarrow$	1	n	0
1	1	n	0
n	1	n	n
0	1	1	1

$\neg$	
1	0
n	n
0	1

- $\exists x \phi$ is true if ϕ is true of something, otherwise it is false.

Lehmann (2002, 234) stipulates that

- $\forall x \phi$ is true if ϕ is true of everything, otherwise it is false
- $\exists x \phi$ is true if ϕ is true of something, otherwise it is false.

Smiley (1959, p. 126) provides the following trivalent rules for the quantifiers:

- $\forall x \phi$ is true if ϕ is true of everything, it is false if ϕ is false of something, otherwise it is neither true nor false
- $\exists x \phi$ is true if ϕ is true of something, it is false if ϕ is false of everything, otherwise it is neither true nor false.

We are now in a position to discuss the treatment of existence hedges in the different systems of neutral free logic.

3 Pryor's Solution and Yeakel's Dilemma

Pryor (2006a) opts for weak Kleene truth tables and Lehmann (1994)'s bivalent rules for the quantifiers. Given his choice for weak Kleene truth tables, Pryor (2006a, p. 337) realised that (H) cannot be formalised as follows:

Jack exists $\rightarrow$ Jack is self-identical.

Indeed, if 'Jack' does not denote anything, then the antecedent is neither true nor false, so the conditional is neither true nor false. Thus, the conditional is not a logical truth, so that is not a basis for (H) being knowable a priori. Conversely, if the above conditional is true, then 'Jack' denotes something and, hence, (E) is true as well. But then (H), if so formalised, would entail (E), just like (I) does. Instead, Pryor formalised (H) as follows:[4]

(H') $\forall x(\text{Jack} = x \rightarrow x = x)$

[4]Pryor (2006a, p. 338) formalised (H) as $\neg\exists x(\text{Jack} = x \wedge \neg\text{Jack} = \text{Jack})$, which is equivalent to $\forall x(\text{Jack} = x \rightarrow \text{Jack} = \text{Jack})$, given Lehmann (1994)'s bivalent rules for the quantifiers. Pryor (2006b, p. 20) formalised (H) as (H'). As Yeakel (2016, p. 384) points out, the latter is a direct formalization of 'If Jack exists, then *he* is self-identical'. Yet, I will follow Pryor (2006b) and Yeakel (2016) in using the formalization (H'), in which 'Jack' does not occur in the consequent.

Furthermore, he formalised (E) as follows:

(E′) $\exists x(\text{Jack} = x)$

Fortunately, (H′) does not entail (E′). For suppose that 'Jack' does not denote anything. Then Jack $= x$ is not false of something, so (H′) is true.[5] Moreover, Jack $= x$ is then not true of anything, so (E′) is false. So, in the system of Pryor (2006a) the existence hedge does not entail the unwanted existence claim. The puzzle for semantic externalism seems to have been solved.

However, there is a problem with *partial* existence hedges. Consider the following sentence, which only hedges against the non-existence of Jack but not of Jiho, and its formalisation (Pryor, 2006b, pp. 10–11):

(PH) If Jack exists, then Jack is younger than Jiho.

(PH′) $\forall x(\text{Jack} = x \rightarrow x < \text{Jiho})$

While (PH′) does not entail (E′), it also does not entail that Jiho exists. So, in the system of Pryor (2006a) some partial existence hedge does not entail some wanted existence claim.

This brings Pryor (2006b, p. 13) to opt instead for strong Kleene truth tables and trivalent rules for the quantifiers. But there is still a problem with partial existence hedges. Consider the following sentence, which only hedges against the non-existence of Jack but not of Jiho, and its formalisation:

> If Jack exists, then either he is self-identical or he is younger than Jiho.

(i) $\forall x(\text{Jack} = x \rightarrow (x = x \vee x < \text{Jiho}))$

Regrettably, (i) does not entail the existence of Jiho. For $x = x$ is true of everything and, therefore, $x = x \vee x < \text{Jiho}$ and $\text{Jack} = x \rightarrow (x = x \vee x < \text{Jiho})$ are also true of everything. So, in the system of Pryor (2006b) some partial existence hedge does not entail some wanted existence claim.[6] Furthermore, there is also a problem with existence hedges. Consider the following sentence and its formalisation:

> If Jack exists, then he is identical to James but not to Kathryn.

(iii) $\forall x(\text{Jack} = x \rightarrow (x = \text{James} \wedge x \neq \text{Kathryn}))$

For suppose that 'Jack' does not denote anything. Then Jack $= x$ is not true of anything. Hence, (iii) is only true if $x = \text{James} \wedge x \neq \text{Kathryn}$ is true of everything, which is only the case if both 'James' and 'Kathryn' denote something. But $x \neq \text{Kathryn}$ is false of the referent of 'Kathryn', so $x =$

[5]Note that, if one opts for Lehmann (2002)'s bivalent rules for the quantifiers, then this step fails.

[6]Pryor (2006b, p. 13) allows empty domains of quantification and stipulates that, if the domain is empty, universally quantified sentences are vacuously true and existentially quantified sentences are vacuously false. Yeakel (2016, p. 383) points out that this makes partial hedging impossible.

James $\wedge x \neq$ Kathryn is not true of everything. Therefore, if 'Jack' does not denote anything, then (iii) is not true. So, in the system of Pryor (2006b) some existence hedge entails some unwanted existence claim.

Finally, Yeakel extends his conclusion to the two remaining options, namely (1) the combination of weak Kleene truth tables and trivalent rules for the quantifiers (McKinsey, 2006) and (2) the combination of strong Kleene truth tables and bivalent rules for the quantifiers. The first option runs into the problem that existence hedges entail some unwanted existence claims. If a sentence like (H′) is true, then Jack $= x \rightarrow x = x$ has to be true of everything, so Jack $= x$ has to be true or false of anything, whence it follows that 'Jack' denotes something.[7] The second option runs into the problem that partial existence hedges do not entail some wanted existence claims. Since $x = x$ is true of everything, Jack $= x \rightarrow (x = x \vee x <$ Jiho) is true of everthing, so (i) is true, even when 'Jiho' denotes nothing.

So, on any system of neutral free logic some existence hedges entail some unwanted existence claims or some partial existence hedges do not entail some wanted existence claims. This conclusion can be generalised to any system of non-positive free logic. As Pryor (2006b, p. 10) points out, in negative free logic (PH′) also does not entail (E′): if 'Jack' does not denote anything, then the antecedent is false of everything, so the conditional is true of everything. Therefore, in negative free logic some existence hedge does not entail some wanted existence claim. Thus the same disjunctive conclusion holds for negative free logic as well. Consequently, the same disjunctive conclusion holds for each of the non-positive varieties of free logic.

Next, it will shown how with an extension of one of the systems of neutral free logic one can escape Yeakel's dilemma.

4 Existence Hedges with Truth: Escaping Yeakel's Dilemma

As a base system of neutral free logic, I opt for the combination of weak Kleene truth tables with trivalent rules for the quantifiers. Later we will see that this is the only choice if one wants to escape from Yeakel's dilemma regarding existence hedges.[8]

[7]This also holds for the combination of weak Kleene truth tables and Lehmann (2002)'s bivalent rules for the quantifiers

[8]Independently of the issue of existence hedges, the choice for the combination of weak Kleene truth tables with trivalent rules for quantifiers is sometimes motivated by the No-Input-No-Output (NINO) principle (Lehmann, 1994, p. 310): the semantical value of a complex expression is a function of the semantical values of its constituent expressions. As Rami (2021, pp. 9491–9492) points out, if one a system of logic assigns any semantical value, including the neutrality value, to formulas that contain a term without a semantical value, then this is a violation of NINO. Hence, the neutrality value should be replaced with 'undefined truth-value'. The result is a *partial* but *bivalent* logic: the satisfaction function is a partial function but there are only two values (truth, falsity) that are assigned in case the function value is defined (Smiley, 1959, pp. 126-127). However, to ease the comparison with the preceding sections, I will continue to speak in the main text of

I will follow Smiley (1959, p. 128)'s lead and extend the language with a truth operator T, for which he uses the following stipulation:

- $T\phi$ is true (of something) if ϕ is true (of it), otherwise it is false (of it).

Note that formulas of the form $T\phi$ are bivalent.[9]

The base system of neutral free logic with trivalent rules for the quantifiers cannot express true non-existence claims. The sentence $\exists x t = x$ is true if t denotes something, but it is neither true nor false if t denotes nothing. Consequently, $\neg\exists x t = x$ is neither true nor false, if t denotes nothing. The inability to express true non-existence claims with trivalent rules for the quantifiers in place has been cited as an important reason to prefer the bivalent rules for the quantifiers. On both Lehmann (1994)'s and Lehmann (2002)'s bivalent rules, $\exists x t = x$ is false if t does not denote anything. Within the extended logic, one can express existence claims as follows:[10]

(TE) $\exists x \mathrm{T} x = t$

The above is true if t denotes something and it is false if t denotes nothing.[11] So, $\neg\exists x \mathrm{T} x = t$ is true if t denotes nothing. Thus, an important reason for preferring bivalent rules for the quantifiers over the trivalent rules for the quantifiers is undermined.

Whereas the base system of neutral free logic with trivalent rules for the quantifiers runs into the problem that existence hedges entail some unwanted

trivalence.

[9]One might object that the bivalence of $T\phi$ conflicts with NINO, when ϕ contains a non-denoting term. To avoid this objection, it might be better to work with a truth predicate that combines with names of sentences or Gödel codes of sentences, in which possibly non-denoting terms occurring in those sentences are not used but mentioned or coded. But I will keep it simple, by not using a theory of syntax or number theory.

[10]Smiley (1959, p. 129) proposes to define 't exists' as '$\mathrm{T}t = t$', which is equivalent to (TE).

[11]An anonymous reviewer raised the worry that this is the so-called 'metalinguistic analysis' of negative existential claims, which Kripke (2013, Lecture 6) has forcefully argued against. Kripke's first argument is that the counterfactual use of names to refer to something and the counterfactual existence of the things or persons named are separate: if in some world 'Vulcan' was used to refer to something at that world, it would not entail that Vulcan exists at that world; Moses could have existed in some world, even if nobody at that world had been named 'Moses'. In the body of this paper we are not considering modality, but here is a sketch of how to deal with the problem. In the structures for the modal language individual constants are assigned a denotation or not, irrelative to worlds. (In the terminology of Salmon (1981, p. 34), they are obstinately rigid designators, if they are designators at all.) With world-relative quantifiers, (TE) is true at a given world, if the individual constant has a defined denotation that exists at the given world, and (TE) is false at the given world, if the individual constant does not have a defined denotation or it does have one but it does not exist at the given world. In contrast, one might add a reference predicate R to the language and one make its interpretation world-relative, just like for the other predicates of the language. If one then also adds names of names (e.g., quoted names), then one can use, for example, $\exists x R(`t', x)$ to express that '$t$' is used at a world to refer to something existing at that world. The truth of (TE) at a world is separate from the truth of $\exists x R(`t', x)$ at a world. If one were to reformulate (TE) with the help of a truth predicate and names of sentences rather than a sentence operator (see footnote 8), then this would not change anything, as long as the names of sentences denote the sentences irrelative to worlds. A discussion of Kripke's second and third argument fall outside the scope of this footnote, but the foregoing should reassure the reader that the proposal is not the same as the metalinguistic analysis of existence claims.

existence claims, the extended system can deal adequately with existence hedges. Suppose that $\phi(t)$ is a formula in which t occurs but in which T does not occur. The formula $\phi(x/t)$ is the result of substituting the variable x for t in ϕ (assuming that x occurs freely in $\phi(x/t)$). Then one can express a hedged existence claim as follows:[12]

(TH) $\forall x \left(\mathrm{T}x = t \rightarrow \phi(x/t)\right)$

Existence hedges with the truth operator do not entail unwanted existence claims. If t does not denote anything, then $x = t$ is neither true nor false of anything, so $x = t$ is not true of anything, whence it follows that $\mathrm{T}x = t$ is false of everything. Moreover, since t does not occur in $\phi(x/t)$, the latter is true or false if it does not contain any other non-denoting term. So, in that case $\mathrm{T}x = t \rightarrow \phi(x/t)$ is true of everything, whence it follows that (TH) is true. Furthermore, existence hedges with the truth operator do entail wanted existence claims: if t' occurs in ϕ, then the truth of (TH) entails that t' denotes something. If t' occurs in $\phi(x/t)$ and if t' does not denote anything, then $\phi(x/t)$ is neither true nor false of anything, given that T does not occur in ϕ. Consequently, $\mathrm{T}x = t \rightarrow \phi(x/t)$ is neither true nor false of anything, so it is not true of anything, whence it follows that (TH) is not true. The proposed system escapes Yeakel's dilemma.

Returning to the motivation for the base system, note that if the base system had used the strong Kleene truth tables, then even in the extended system some partial hedges would still not entail some wanted existence claims. Consider the following reformulation of (i):

(iv) $\forall x(\mathrm{T}x = \text{Jack} \rightarrow (x = x \vee x < \text{Jiho}))$

The left disjunct of the consequent, namely $x = x$, would still be true of everything and, applying the strong Kleene truth tables, the consequent and hence the conditional would still be true of everything. On any of the quantifier rules, this means that (iv) is true, even if 'Jiho' does not denote anything. In contrast, in the chosen system, which uses weak Kleene truth tables, the truth of (iv) does entail that 'Jiho' denotes something. Next, suppose that the base system had combined weak Kleene truth tables with bivalent rules for the quantifiers. Recall that one important reason for using bivalent rules for the quantifiers, namely to express true non-existence claims, has already been undermined. Now we will see reasons against those rules. If 'Jiho' denotes nothing, then the conditional of (iv) is neither true nor false of anything and, hence, it is not false of anything, so according to Lehmann (1994)'s bivalent rules (iv) is true. We would again face the problem that some partial hedges would still not entail some wanted existence claims.

That leaves the combination of weak Kleene truth tables and Lehmann (2002)'s bivalent rules for the quantifiers. With this combination the truth of (iv) does entail that 'Jiho' denotes something. But the drawback of these quantifier

[12] If one uses a truth predicate T and Gödel numbers instead, then the antecedent should be $T\ulcorner t = \dot{x}\urcorner$, which uses Feferman's dot notation to allow quantifying into the Gödel number $\ulcorner \dot{x} = t\urcorner$.

rules is that they break quantifier exchangeability — see also Yeakel (2016, p. 381, fn. 2). A sentence of the form $\exists x\phi$ might be false, while $\neg\forall x\neg\phi$ is true. Consider again (E′.) If 'Jack' does not denote anything, then x = Jack is neither true nor false of anything, so x = Jack is not true of something. Hence, (E′) is false. Yet, in that same case $\neg x$ = Jack is neither true nor false of everything, so $\neg x$ = Jack is not true of everything, so $\forall x\neg x$ = Jack is false. Hence, $\neg\forall x\neg x$ = Jack is true. Similarly, a sentence of the form $\forall x\phi$ might be false, while $\neg\exists x\neg\phi$ is true. Consider again (H′). If 'Jack' does not denote anything, then x = Jack is neither true nor false of anything and, consequently x = Jack $\rightarrow x = x$ is neither true nor false of anything, so it is not true of everything and, therefore, (H′) is false. Yet, in that same case $\neg(x$ = Jack $\rightarrow x = x)$ is also neither true nor false of anything and, consequently, $\neg(x$ = Jack $\rightarrow x = x)$ is not true of something and, therefore, $\exists x\neg(x$ = Jack $\rightarrow x = x)$ is false. Hence, $\neg\exists x\neg(x$ = Jack $\rightarrow x = x)$ is true.

In conclusion, the extension of the base system of neutral free logic, which combines weak Kleene truth tables with trivalent rules for the quantifiers, with a truth operator allows one to express true non-existence claims and to express existence hedges, while escaping the horns of Yeakel's dilemma. Changes to the base system, namely opting instead for strong Kleene truth tables or bivalent rules for the quantifiers, bring back Yeakel's dilemma or they break quantifier exchangeability. So, there is at least one extension of a non-positive free logic that can deal adequately with existence hedges. Moreover, it is clear that extending negative free logic with a truth operator does not lead to an escape from the dilemma. If 'Jack' does not denote anything, then Jack = x is false of everything and, therefore, TJack = x is false of everything and, consequently, TJack = $x \rightarrow x <$ Jiho) is true of everything and, hence, $\forall x$(TJack = $x \rightarrow x <$ Jiho) is true, even when 'Jiho' denotes nothing. So it is still the case that some existence hedge entails some wanted existence claim.

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