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Monstrous Puzzles and Shifty Operators

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ABSTRACT

I review extant literature on English indexicals, indexical shift, and cross-linguistic "shifty operator" theory; then apply the methods of the theory to English data of a specific semantic structure. I find that the English data conforms with cross-linguistic expectations of indexical shift and the "shifty operators" make correct predictions about the referents of the indexicals involved.

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1 Introduction

1.1 The phenomenon

An INDEXICAL is a word whose referent depends on the context in which it occurs. For example, the word *now* refers to the time, *I* to the speaker, and *here* to the location. INDEXICAL SHIFT is the phenomenon whereby an indexical's referent changes due to the composition of an utterance; *now* referring somehow to a time which is not the one at which the utterance was spoken. While difficult to represent in English, imagine the following were understood according to the subscript annotations of reference:

(1) #In the year 700$_1$, the country will now$_1$ be ruled by a count.

It appears to be widely agreed that such a reading is not licensed. In certain languages however, and in certain combinations of modals and indexicals, the shift does occur. Consider:

(2) Amharic (Schlenker, 2003, p. 68)
    ǰon   ǰəgna   nə-ññ   yɨl-all
    John   hero   be.PFV−1S.O   3M.say-AUX.3M
    John$_1$ says that he$_1$ is a hero. (lit. 'John$_1$ says that I$_1$ am a hero.)

In this example it is clear that, in Amharic, it is perfectly well for embedded first-person pronouns to choose referents from somewhere that is not the utterance context; John is not stating that *I*, the speaker, am a hero, which is the reading that would arise from the equivalent English utterance. This is the phenomenon of indexical shift at large.

1.2 Indexical shift in English

Upon first consideration, English seems to simply forbid the shifting of indexicals, where other languages do not. This is the opinion of Kaplan (1989), discussed later. However, an example by Santorio (2010) demonstrates what that author believes to be a case of indexical shift in English. The following is a puzzle adapted from that paper demonstrating the phenomenon.

> You cast a *teleport* spell in an attempt to travel to the city of Waterdeep. As an inexperienced magician, you know there is a chance your spell will fail and you will arrive instead in the city of Baldur's Gate. You appear in urban surroundings that you do not recognise; unbeknownst to you, they are those of the city of Waterdeep, and your spell has succeeded. You gesture at the environment and you say:

(3)   If the spell succeeded, this is Waterdeep.

(4)   If the spell failed, this is Baldur's Gate.

We can see that when embedded in a conditional, it is entirely felicitous, or appropriate, to utter both (3) and (4), despite the approach from Kaplan (1989) predicting otherwise: that these utterances are equivalent to *If the spell succeeded, Waterdeep is Waterdeep; if the spell failed, Waterdeep is Baldur's Gate.* Notice that if the spell had failed, and you stood instead in Baldur's Gate, your utterances would *still* be infelicitous under the Kaplan approach: *...Baldur's Gate is Waterdeep*[1].... Details on why this is so are reserved for Section 2.1 below.

Santorio goes on to generalise the problem "for other indexicals and for other modals" (Santorio, 2010, p. 292); specifically, the paper suggests that it arises with all English indexicals and all epistemic and doxastic modals (note that the conditional example above contains an implicit belief-report, discussed in detail in Section 2.2). I refer to examples like the one above, which end with an utterance or set of utterances that appear to demonstrate English indexical shift, as SANTORIO-STYLE PUZZLES throughout this paper. I construct more puzzles of this nature later, in service of analysing them with other modals and indexicals.

The Santorio paper describes one possible theory to capture the data it presents, but it does not address the question of how, if at all, these puzzles relate to 'confirmed' occurrences of indexical shift in other languages. In this paper I compare the Santorio-style puzzles to cross-linguistic data from Anand & Nevins (2004) and Deal (2020), demonstrating what, if anything, sets English apart from the 'indexical-shift languages' those papers discuss. I apply the SHIFTY OPERATOR THEORY proposed by Anand & Nevins and iterated upon by Deal to the Santorio-style puzzles, and explain how it captures that data.

This paper proceeds as follows: in Section 2, I establish necessary background for understanding indexicals (Section 2.1), Santorio-style puzzles and their construction (Section 2.2), Anand & Nevins' shifty operator theory and Deal's additions to it (Section 2.3), alternative explanations for language-specific indexical shift phenomena (Section 2.4), and Deal's generalisations about indexical shift cross-linguistically (Section 2.5). In Section 3, I compare the conclusions made based on that background to Santorio-style puzzles and perform a semantic derivation of one such puzzle that incorporates the shifty operator theory. Finally in Section 4 I consider the outcome of incorporating shifty operators into English and the positive and negative consequences of their use.

I find that the shifty operators do, from a preliminary analysis, describe Santorio-style puzzles. Specifically, an operator which overwrites every contextual feature with

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[1]These fictional locations come courtesy of Greenwood et al. (2001).

the equivalent circumstantial one makes the correct predictions about the referents of all embedded indexicals in the puzzle and eliminates the internal contradiction created by a Kaplan-style analysis. I conclude with a series of suggestions for additional analysis of the interaction between shifty operator theory and English indexicals that this paper does not address.

2 Background

2.1 Kaplan

I first discuss Kaplan (1989), because it is foundational to the discussion of indexicals and indexical shift at large. Specifically, much of the later terminology used in the discussion of indexical shift originates from that paper; and to a reader with a modern perspective, the particular usage of these terms and how they have evolved is not immediately clear. The paper additionally appears to be first to note the facts about indexicals which create the apparent underlying contradiction between utterances like the aforementioned (3) and (4); a contradiction this paper goes on to discuss in detail.

This section condenses some of Kaplan's miscellaneous definitions with his section VI, *Terminological Remarks* (Kaplan, 1989, pp. 500—506). First, as is widely accepted still in discussion of indexicals, he distinguishes between PURE and DEMONSTRATIVE indexicals. A demonstrative, claims Kaplan, is an indexical which requires an associated DEMONSTRATION (for example, pointing) to determine its referent. A pure indexical is one which does not. The referent of a demonstrative is called its DEMONSTRATUM. Some indexicals, such as *here*, can be either (pointing to a spot on a map, for example, in contrast with simply referring to one's current location *sans* gesture). These definitions of where pure and demonstrative indexicals derive their referents comprise what Kaplan calls his **Principle 1**.

Kaplan also distinguishes CONTEXTS OF USE ('contexts') from CIRCUMSTANCES OF EVALUATION ('circumstances'). Contexts are sets of features associated with an utterance: its speaker, the current time, location, and so on (not to be confused with the typical linguistic features: a 'feature' of a context is simply an element of the set). Circumstances are analogous to possible worlds; the things which propositions are evaluated at to produce truth-values. What features actually make up the context and circumstance may vary; Kaplan proposes an n-ple; his default arrangement is speaker, addressee, time, and place, but he adds regarding their relation to one another: "all the features of a circumstance will generally be required as aspects of a context, and the aspects of a context may all be features of a circumstance."(Kaplan, 1989, p. 511); which is to say, the exact contents of each set are unknown, uncertain, and may be sub- or super-sets of one another. In any case, we may slightly amend Principle 1 to say that *pure indexicals derive their referents from context*.

Kaplan's theory depends on the idea that indexicals are DIRECTLY REFERENTIAL. A directly referential term has a referent which is fixed for *all* circumstances; therefore its intensional content is always the same. It does not simply incidentally pick out the same referent in every circumstance by means of complex semantics; it has semantics which are exactly that referent. Kaplan's claim that indexicals are directly referential is what he calls his **Principle 2**.

There are two relevant kinds of meaning in Kaplan's theory. The first is CONTENT, which is the intension of a term. This is a function from circumstances to extensions. There is also CHARACTER, the 'meaning' of an indexical, which is a function from contexts to contents. For example, a rule like

The indexical *here* refers to the location of an utterance.

would allow us to derive the referent, and therefore (as indexicals are directly referential!) the content of *here* in an utterance which contained it. We can thus take an utterance like:

(5)   I am writing from here.

and from the character of *I* and *here* and the context determine that the content of *I* should be ⟦Lucy⟧ and the content of *here* should be ⟦Edinburgh⟧ and then from that content are the extensions, myself and my university, picked out. Now circumstances come into play, and no earlier: the propositional content produced by these intensional substitutions may be evaluated at any given circumstance.

A MONSTER is an operator, such as a modal, which would shift an indexical as in (1) above. Kaplan (1989, p. 510) supplies an example of an attempt to create a monster in English, reproduced here.

(6)   In some contexts it is true that I am not tired now.

In (6), *In some contexts it is true that* is meant to be a monstrous operator. However, Kaplan is quick to point out that it does not function as intended—*now* "leaps out" to a scope higher than the operator (Kaplan, 1989, p. 510), and appears still to refer to the context of the utterance. According to Kaplan, monsters do not and cannot exist in English. Kaplan states that indexicals always use the highest possible scope, and cannot be contained any lower except by mentioning it rather than using it, such as in quotation.

The notion that monsters, perhaps better (and henceforth) called CONTEXT-SHIFTING OPERATORS, do not exist in and could not be added to English is chiefly what later authors disagree with.

2.2 Santorio-style puzzles

The construction of Santorio-style puzzles like in Section 1.2 above warrants some explanation; specifically, a demonstration of which aspects of the puzzle cause conflicts with Kaplan's theory. I will use several more puzzles constructed in this way as data for analysis, following a discussion of cross-linguistic data.

The truth-conditions for *if* that define examples with that modal are those by Stalnaker (1968); reproduced from Santorio (2010) with minor alterations (the result of clarifications from von Fintel (2019)):

$[\![\text{if } p, q]\!]^{c,g} = 1$ iff $\forall\ w'$ compatible with what the speaker knows in w_c such that $w' \in [\![p]\!]^{c,g}$, $w' \in [\![q]\!]^{c,g}$

We assume that this analysis is necessary on a broader scale for reasons which are beyond the scope of this paper (discussed in detail in the aforementioned chapter by von Fintel); however, we can see why a straightforward material conditional approach would be unable to capture the indexical shift data by the following example. Here is almost the simplest possible puzzle of this form: I am lost in the woods between Waterdeep and Baldur's Gate; I emerge from the woods and point to the city before me and utter *If I have emerged from the northern end of the forest, that is Waterdeep; if the southern, that is Baldur's Gate.*

Without taking any approach whatsoever to the evaluation of indexicals, we can see that the intensions of these conditionals are:

(7) $= 1$ iff $\forall\ w'$ compatible with what the speaker knows in w_c such that $w' \in [\![\text{I have emerged from the northern end of the forest}]\!]^{c,g}$, $w' \in [\![\text{that is Waterdeep}]\!]^{c,g}$

(8) $= 1$ iff $\forall\ w'$ compatible with what the speaker knows in w_c such that $w' \in [\![\text{...southern end of the forest}]\!]^{c,g}$, $w' \in [\![\text{that is Baldur's Gate}]\!]^{c,g}$

Let us consider the worlds in my epistemic state. Compatible with my knowledge are the propositions p in either case: that I emerged from the north or from the south, and so if my two utterances are true then the propositions q in both cases (the consequents of the two utterances) should be true. In other words, both the antecedent and the consequent must be compatible with the worlds in my epistemic state. This is no trouble with a pair of utterances that do not contain indexicals, but if we apply Kaplan's Principle 2, that all indexicals are directly referential, we cannot stop at (7) and (8). The intensional contents of *that* in both utterances must be substituted for the indexicals' referents in the real world; and so, in a situation where I have *in fact* emerged from the northern end of the forest, the real truth-conditions are:

(9)   = 1 iff ∀ w' compatible with what the speaker knows in w_c such that $w' \in$ ⟦I have emerged from the northern end of the forest⟧ ^{c,g}, $w' \in$ ⟦Waterdeep is Waterdeep⟧ ^{c,g}

(10)   = 1 iff ∀ w' compatible with what the speaker knows in w_c such that $w' \in$ ⟦...southern end of the forest⟧ ^{c,g}, $w' \in$ ⟦Waterdeep is Baldur's Gate⟧ ^{c,g}

We know that, in reality, the city to which I am pointing is Waterdeep. As such, the character of *that* tells us that the content of my indexical is ⟦Waterdeep⟧. But now one of my utterances is false! That Waterdeep 'is' Baldur's Gate is *not* compatible with my knowledge in w_c; I do not know what it would mean if it were. As previously demonstrated, if any of p or q is false, the whole of the utterance is false, according to these truth-conditions. But it is clear that both utterances are 'true' in some sense. The solution, according to Santorio, is to assume that something about Kaplan's theory (the process by which we decide the intension of q) is flawed.

I say all this to avoid confusion with the result a material conditional analysis would give. One might suppose that there is nothing wrong at all with the pair of utterances if they are:

(11)   =1 iff ⟦I have emerged from the northern end of the forest⟧ in w_c → ⟦Waterdeep is Waterdeep⟧ in w_c

(12)   =1 iff ⟦I have emerged from the southern end of the forest⟧ in w_c → ⟦Baldur's Gate is Waterdeep⟧ in w_c

Here, that the consequent is false in (12) does not matter, because the antecedent is false also. Now both utterances are true under any analysis. But this is not a suitable analysis of conditionals at all; I refer again to the chapter by von Fintel (2019).

Fortunately for the analysis of these puzzles, Santorio claims that it is perfectly possible to construct them with other modals. I find that the standard way to do so is to consider a situation where a speaker is uncertain about a fact of the circumstance they are in: the location, time, speaker, or addressee, to borrow from Kaplan's suggestions for circumstantial features which are relevant to indexicals. Following that, produce an utterance or utterances whereby two conditional statements embed modals in their consequents, which themselves are sown with indexicals:

(13) a. "Either I have emerged from the north, so p = [that must be Water-deep]; or I have emerged from the south, so q = [that must be Baldur's Gate]."

b. In fact, the demonstrated city is Waterdeep.

c. p = [Waterdeep must be Waterdeep]; q = [Waterdeep must be Baldur's Gate]

d. Speaker does *not* believe both p and q are compatible with epistemic state.

(14) a. "If I have emerged from the north, I believe that is Waterdeep. If I have emerged from the south, I believe that is Baldur's Gate."

b. In fact, the demonstrated city is Baldur's Gate.

c. "If I have emerged from the north, I believe Baldur's Gate is Water-deep. If I have emerged from the south, I believe Baldur's Gate is Baldur's Gate."

This produces the "shifty" reading of the indexicals. Under a Kaplan-style analysis of the indexicals within these clauses, when taken together no single individual may act as the intension of the indexicals in both clauses without producing a contradiction. We may refer back to (7) and (8) for the truth-conditions of (14), as we have already adopted an analysis of conditionals as epistemic restrictors which removes the need for *I believe* in the consequents of the utterance.

These truth-conditions are sufficiently robust for the analysis this paper is concerned with. I will use this process again to construct and analyse Santorio-style puzzles following a discussion of cross-linguistic indexical shift phenomena and shifty operator theory.

2.3   The cross-linguistic case for shifty operators

Indexical shift is certainly possible in languages other than English. I will call these languages which 'obviously and consistently' shift indexicals INDEXICAL-SHIFT LAN-GUAGES. Anand & Nevins (2004) discuss two indexical-shift languages, Zazaki and Slave, and formalise a SHIFTY OPERATOR THEORY to capture that data. Following this I will describe the approach of Deal (2020), who applies this theory to Nez Perce[2] and rejects several alternatives. Deal also makes several assertions about indexical-shift languages and stipulations regarding shifty operator theory that will be useful for a later comparison to English.

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[2]As background for the languages mentioned: Zazaki is spoken in Turkey by the Kurdish people; Slave in territories in northwestern Canada; and Nez Perce in territories in the northwestern United States.

2.3.1 Data from Zazaki and Slave

Based on their data, Anand & Nevins make a few useful generalisations about indexical-shift languages. The first they call the **Shift-Together Constraint**: all indexicals embedded under the same context must either shift or not; they cannot shift independently. Consider (15) and (16), which are ambiguous.

(15) Zazaki (Anand & Nevins, 2004, p. 21)
Hɛseni_j mɨk-ra va kɛ ɛz_{j/k} dɛwletia.
Hesen.ᴏʙʟ I.ᴏʙʟ-to said that 1sɢ rich.be
'Hesen said that {I am, Hesen is} rich.'

(16) Zazaki (Anand & Nevins, 2004, p. 23)
Vizeri   Rojda Bill-ra va   kɛ   ɛz
Yesterday Rojda Bill-to said that 1sɢ
to-ra   miradiša.
2sɢ-to   angry.be-ᴘʀᴇs
'Yesterday Rojda said to Bill that {I am, Rojda is} angry at {you, Bill}.'

Anand & Nevins indicate that (15) should be ambiguous between two meanings (it is) and (16) between four. But the latter is not. The readings corresponding to English *Rojda is angry at you* and *I am angry at Bill* are not available; the two embedded indexicals cannot choose referents from different contexts.

They also find that, at least in Slave, the modal under which an indexical is embedded affects whether it must, may, or must not shift. Furthermore, some modals affect only certain indexicals, and to varying degrees.

(17) Slave (Anand & Nevins, 2004, p. 31)
John [beya   ráwoz'ɨe]   yudeli.
John [1sɢ-son 3sɢ-will-hunt] 3sɢ-want-4sɢ
John wants {his, my} son to go hunting.

(18) Slave (Anand & Nevins, 2004, p. 31)
Simon [ráseyerineht'u] hadi.
Simon [2sɢ-hit-1sɢ]   3sɢ-say
Simon said that you hit him.

We see that (17) is ambiguous, while (18) is not (a *Simon said that you hit me* reading is not allowed). This is because, according to the data from Anand & Nevins, Slave ᴡᴀɴᴛ is a predicate which optionally shifts first-person indexicals. sᴀʏ by contrast is one which *obligatorily* shifts first-person indexicals, and does not shift others. A later amendment by Deal (2020) reconciles the Shift-Together Constraint with the

evident idea that only certain indexicals under certain modals must or may shift; this is discussed below in Section 2.3.2, which regards that paper.

Anand & Nevins arrive at a theory whereby an OP operator accompanies modals and is responsible for overwriting the variables of the context with the variables of the circumstance. Their process makes use of the *context* and *index* parameters, which warrant some explanation (further discussion appears in Zimmerman (1991)). Broadly, the context parameter c is as described by Kaplan (1989) and summarized earlier, and the index parameter i manages world and time information; it is an analogue to the circumstance. The typical assignment function g still pertains, but it is irrelevant here. Anand & Nevins provide the circumstantial features—parameters of the evaluation world—by adapting the *context* and *index* parameters such that the types of c and i are the same; that is, such that the two both contain speaker, place, and time information, *et cetera* (note that this move comes full-circle from Kaplan's similar suggestion). This type is referred to as κ, based on the convention chosen by Deal (2020), discussed later. When operators in Zazaki shift indexicals, the OP operator overwrites every feature of the context c with every feature from the adapted index parameter i, which can at this point be thought of as the circumstance:

(19) $[\![\text{OP}_\forall \, p]\!]^{\varsigma \, i} = [\![p]\!]^{i \, i}$

When they shift in Slave, to account for the variation in modal indexical shifting observed, the operator overwrites only certain relevant features of the context. For example, we have seen that Slave SAY obligatorily shifts first-person indexicals; it would, therefore, use an OPAUTH:

(20) $[\![\text{OPAUTH} \, p]\!]^{\varsigma \, i} = [\![p]\!]^{k \, i}$

Where k is a set of features identical to c, except that its 'author' feature has been overwritten with that of i. This remains aligned with Kaplan's content and character observations: terms in the expression which typically find meaning from the context c still do so, and indexical terms find theirs from the context under which they are embedded; only, this is a context k, which differs from the wider one; created by the operator, using the set of features i from the circumstance. By way of example, imagine that κ is an ordered set that looks like {*speaker, addressee, location, time, world*}. Suppose a Slave utterance with a context of {Urwin, Danika, Barovia, noon, w} (called c) contains a first-person pronoun embedded under the predicate SAY. SAY would be accompanied by an index parameter i, which contains the relevant circumstantial features; suppose these are {Victor, Urwin, Barovia, last week, w'}. The utterance is already known to possess this parameter as a consequence of models of other operators, as described in Zimmerman (1991). SAY would also have attached to it the operator in (20), OPAUTH, which has the semantic power to overwrite the

addressee of c with the addressee of i, the index parameter. Once the operator has done its work, the context at which the embedded first-person pronoun is evaluated is now {**Victor**, Danika, Barovia, noon, w}.[3] The addressee and time features, though different between c and i, are not all overwritten, as OPAUTH is designed only to operate on the author feature.

This is clearly directly against Kaplan's idea that indexicals always take primary scope, and this is exactly the place where the behaviour of indexical-shift languages differs from Kaplan's notion of the behaviour of English. The advantage of using this operator is that the behaviour of other elements which rely on the context and index parameters is unaffected unless (and this is a preview of the discussion to follow) the operator's destructive change to the context has second-order consequences; furthermore, it is unnecessary to change the underlying behaviour of the indexicals themselves from Kaplan's original observations.

These CONTEXT-SHIFTING OPERATORS provide one approach to capturing indexical shift cross-linguistically. They account for the observed Shift-Together Constraint and allow different predicates to affect which indexicals may shift and whether or not they must. I go on to discuss how Deal (2020) applies this shifty operator theory to Nez Perce.

2.3.2 Deal on Nez Perce

Nez Perce is another indexical-shift language. It behaves similarly to Zazaki and Slave, and helps to corroborate that data cross-linguistically; but most importantly, it is the language around which Deal has built her modifications to the shifty operator theory. Consider two pieces of Nez Perce data, which are ambiguous in a way similar to (15):

(21) Nez Perce (Deal, 2020, p. 9)
Sue   hi-i-caa-qa
Sue.NOM   3SUBJ-say-IMPERF-REC.PAST
['iin   k'oomay-ca-Ø].
[1SG.NOM   be.sick-IMPERF-PRES]
Sue$_i$ said {that she$_i$ is sick, "I$_i$ am sick"}.

(22) Nez Perce (Deal, 2020, p. 30)
Isii-ne$_i$ A.   hi-i-caa-qa
who-ACC   A-NOM   3SUBJ-say-IMPERF-REC.PAST
[cewcewin'es-ki *pro*   'e-muu-ce-Ø t_i]?
[phone-with   1SG   3OBJ-call-IMPERF-PRES   ]
Who did A$_j$ say {I, she$_j$} was calling?

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[3] These fictional locations and individuals sourced from Crawford et al. (2016).

The shifted and unshifted readings can be recovered in the same way as described by those authors. The character of *pro*.1SG is that it picks out the author of a context (here c), and so for an unshifted reading the content can be found somewhat like this:

(23) $[\![pro.\text{1SG}]\!]^{c,i} = $ *The author of c*

The intent is to shift the indexical such that its content is selected from a new context; this can be done without changing its character by applying the rule from (19). Deal does exactly that, constructing a shifty operator in the way described by Anand & Nevins; in this case an OP$_{\text{pers}}$ which overwrites the author and addressee of a context with that of a circumstance.

(24)   Nez Perce (Deal, 2020, p. 30)

Isii-ne$_i$	A.	hi-i-caa-qa	[**OP$_{\text{pers}}$**
who-ACC	A-NOM	3SUBJ-say-IMPERF-REC.PAST	[OP
cewcewin'es-ki	*pro*	'e-muu-ce-∅	t_i]?
phone-with	1SG	3OBJ-call-IMPERF-PRES	]

Who did A say she was calling?

Now *pro*.1SG and *t* determine referent from the new context given to them by OP$_{\text{pers}}$, and the *Who did A say I was calling* reading vanishes.

As a preview of the treatment I will give to English examples in a later section, what follows is a sketch of the derivation that Deal performs on the Nez Perce data (Deal, 2020, pp. 32-33). The derivation relies on MONSTROUS FUNCTION APPLICATION, a rule from Anand (2006) which states:

MONSTROUS FUNCTION APPLICATION   *If α is a branching node and $\{\beta, \gamma\}$ is the set of its daughters, then for any context c, index i, and assignment g: if $[\![\beta]\!]^{c,i,g}$ is a function whose domain contains $\lambda i'.\lambda c'.[\![\gamma]\!]^{c',i',g}$, then $[\![\alpha]\!]^{c,i,g} = [\![\beta]\!]^{c,i,g}(\lambda i'.\lambda c'.[\![\gamma]\!]^{c',i',g})$.*

The derivation of (24), in its unshifted reading, is as follows:

$[\![A\ SAY\ [_{CP}\ I\ CALL\ t_2]]\!]^{c,i,g} = 1$ iff $\forall i' \in R_{say}(A, i)[\![I\ CALL\ t_2]\!]^{c,i',g} = 1$

$[\![A\ SAY\ [_{CP}\ I\ CALL\ t_2]]\!]^{c,i,g} = 1$ iff $\forall i' \in R_{say}(A, i)[\text{ AUTH}_c \text{ calls } g(2) \text{ at } t_{i'} \text{ in } w_{i'}]$

Deal describes the OP$_{\text{pers}}$ operator based on that shown in (19) and much like the one in (20):

(25)   a. $[\![\text{OP}_{\text{pers}}\ p]\!]^{c,i} = [\![p]\!]^{k,i}$
       b. $k = c\,(\text{AUTH} = \text{AUTH}_i, \text{ADDR} = \text{ADDR}_i)$

And the shifted reading proceeds:

$$[\![A\ SAY\ [_{CP}\ \text{OP}_{\text{pers}}\ I\ CALL\ t_2]\!]\!]^{\,c,i,g} = 1\ \text{iff}\ \forall i' \in R_{say}(A, i)[\![\text{OP}_{\text{pers}}\ I\ CALL\ t_2]\!]^{\,c,i',g} = 1$$

Now for Monstrous Function Application; in accordance with the rule, we see the shifty operator (β in the definition above) compose with the indexical expression (there γ). There are intermediate steps involved which Deal makes explicit (Anand & Nevins do not); I truncate them here, leaving only the end result of the equivalence in (25).

Monstrous Function Application, β Reduction, β Reduction
$$[\![\text{OP}_{\text{pers}}\ I\ CALL\ t_2\ ]\!]^{\,c,i,g} = 1\ \text{iff}\ [\![\ I\ CALL\ t_2\ ]\!]^{\,k,\ i',\ g} = 1$$

$$k = c\,(\text{AUTH} = \text{AUTH}_{i'},\ \text{ADDR} = \text{ADDR}_{i'})$$

The rest is straightforward.

Lexicon
$$[\![\ I\ CALL\ t_2\ ]\!]^{\,k,\ i,\ g} = 1\ \text{iff}\ \text{AUTH}_k\ \text{calls}\ g(2)\ \text{at}\ t_{i'}\ \text{in}\ w_{i'}$$
$$[\![\ I\ CALL\ t_2\ ]\!]^{\,k,\ i,\ g} = 1\ \text{iff}\ \text{AUTH}_{i'}\ \text{calls}\ g(2)\ \text{at}\ t_{i'}\ \text{in}\ w_{i'}$$

Result
$$[\![A\ SAY\ [_{CP}\ \text{OP}_{\text{pers}}\ I\ CALL\ t_2]\!]\!]^{\,c,i,g} = 1\ \text{iff}\ \forall i' \in R_{say}(A, i)[\ \text{AUTH}_{i'}\ \text{calls}\ g(2)\ \text{at}\ t_{i'}\ \text{in}\ w_{i'}]$$

We see the expected outcome: when the author feature AUTH of c is overwritten, the indexical finds, lexically, the author of i'. Nothing about the behaviour of the indexical is changed; it is 'really' still deriving AUTH from c; but what it finds is $\text{AUTH}_{i'}$, cloned there by OP. With this demonstration complete, we return to broader discussion of the theory.

2.4 Oft-rejected alternatives

Having stipulated the shifty operator theory and applied it cross-linguistically, it becomes necessary to consider popular alternatives to explain the phenomenon in indexical-shift languages (recall that we still have not touched English!). One of these is that indexical-shift languages are simply showing quotation in an unusual manner; that a better translation of the shifty reading of (18) might be *Simon said, "You hit me."*. Kaplan showed how this argument is invalid in English when he touched on use-mention distinctions, and Anand & Nevins put forth capable defenses that indexical shift in Zazaki and in Slave cannot be described by quotation.

(26) Zazaki (Anand & Nevins, 2004, p. 21)

Waxto	kɛ	ma	D.-de	bime,	H.		mɨ-ra	va	kɛ
When	that	we	D.-at	were,	H.OBL		me-at	said	that

o	ita	ame	dina.
he	here	came	world

When we were in Diyarbekir, Hesen told me that he was born {here, in D.}.

(27) Slave (Anand & Nevins, 2004, p. 24)

Simon	[rásereyineht'u]	hadi.
Simon	[2.SG-hit-1SG]	3SG-say

Simon said that you hit him.

In (26) and (27), we see sentences formed which would not have the same meaning using direct quotation as they do under an indexical-shifting predicate analysis; it is nonsense to say they might be *Hesen told me, "He was born here."* and *Simon said, "You hit him.".* *he* and *you* are unambiguous third- and second-person pronouns in these examples and are unaffected by indexical shift (this furthermore demonstrates the necessity of Deal's amendment to the Shift-Together Constraint: 'location' indexicals shift here where 'person' indexicals do not). The existence of such examples, which are structurally similar to (15) but cannot be translated into direct quotation, rule out such a translation as an explanation of the phenomenon as a whole.

Deal defends Nez Perce from the same accusation, though the example requires slightly more context: Beth tells Deal she met Harold, who Beth does not know is a teacher. Deal then later utters:

(28) Nez Perce (Deal, 2020, p. 13)

Beth-nim	hi-hi-n-e		*pro*	[*pro*
Beth-ERG	3SUBJ-say-P-REM.PAST		1SG.ACC	[1SG

'e-wewkuny-∅-e	sepehitemenew'etuu-ne].
3OBJ-meet-P-REM.PAST	teacher-ACC]

Beth told me she met the teacher.

A *Beth told me, "I met the teacher"* reading would be inappropriate here, and so we see the same ban on translating the phenomenon in Nez Perce as quotation as in Zazaki and Slave.

Deal (2020) rejects another alternative that will have some relevance to the later comparison with English puzzles: that Nez Perce indexicals are definite descriptions rather than indexical expressions, so its first-person pronoun is better translated as *the speaker* rather than *I*. Kaplan himself, in the same paper discussed in Section 2.1, produced an argument against this notion in English:

(Kaplan, 1989, pp. 519-520)

(29) 'I' means the same as 'the person who utters this token'.

(30) If no one were to utter this token, I would not exist.

This is an amusing counterargument, but Deal makes it clearer what the issue is with the approach:

(31) (Deal, 2020, p. 15)
    a. Whenever Obama is speaking, the speaker is a former president.
    b. #Whenever Obama is speaking, I am a former president.

Then she shows the impropriety of applying the same approach to Nez Perce, which features the same separation between its first-person pronoun and description of *the speaker*:

(32) (Deal, 2020, p. 15)
    a. Ke   mawa   T.   hi-c'iiq-tetu-Ø,
         C   when   T.NOM 3SUBJ-speak-HAB.SG-PRES
         c'iiẋ-new'eet   hii-wes   haama.
         speak-AGT.NOM 3SUBJ-be.PRES man.NOM.
         Whenever T speaks, the speaker is a man.
    b. Ke   mawa   T.   hi-c'iiq-tetu-Ø,   'iin
         C   when   T.NOM 3SUBJ-speak-IMPERF-PRES 1SG.NOM
         wees   haama.
         be.PRES   man.NOM.
         Deal's consultant, female: "Whenever T is speaking, I am a man...?!"

She demonstrates the same for the other Nez Perce indexicals. This counterargument has two purposes: one, to confirm that Nez Perce indexicals are in fact indexical, and two, to confirm that English does *have* indexicals.

2.5 Generalisations

These authors have shown that indexical-shift languages exist, and that they likely contain context-shifting operators. Deal (2020) identifies four generalisations which apply to indexical shift in Nez Perce and which she argues apply cross-linguistically as well:

I *Indexical shift is specific to speech and attitude reports.*

II *Indexical shift operates on a whole-clause basis.*

III *Indexical shift behaviour distinguishes shifty indexicals from bindable anaphoric elements.*

IV *Indexical shift is sensitive to the structure of the embedded clause.*

The first of these Deal argues simply has no known counter-examples; one would look like the utterance in (1), but that reading is inappropriate both in English and in indexical-shift languages when considering equivalent utterances. The second is effectively the Shift-Together Constraint, which I have already shown examples of in multiple languages. The third we have seen an example of already in (26), where the 3sg pronoun in the embedded clause is semantically distinct from the shifty elements, and Deal demonstrates it in Navajo as well like so:

(33) Navajo (Deal, 2020, p. 48)
Jáan [op Mary [op *pro* chidí nahideeshnih] nízin]
John [op Mary [op 1sg car 3.1.f.buy] 3.want]
ní.
3.say
John says Mary$_i$ wants me$_i$ to buy a car.

Where 1sg cannot refer to the speaker or to John. This restriction arises because *nízin* is another predicate which obligatorily shifts first-person pronouns; however, if the pronouns were merely "bindable anaphoric elements", such a restriction would not occur: it would be able to bind to any of the prior-mentioned individuals.

Finally sensitivity to the embedded clause. Deal provides evidence from Uyghur showing how indexical shift is possible in that language only in finite complements of the word *de* 'say', which can take both finite and non-finite complements. (34) shows a finite complement, and (35) shows a non-finite complement.

(34) Uyghur (Deal, 2020, p. 48)
Tursun Muhemmet-ke [*pro* xet jaz-ding]
Tursun Muhemmet-dat [2sg letter write-past.2sg]
di-di.
say-past.3
Tursun told Mehummet$_i$ that he$_i$ wrote a letter.

(35) Uyghur (Deal, 2020, p. 48)
Tursun Muhemmet-ke [*pro* xet
Tursun Muhemmet-dat [2sg letter
jaz-ghan-lik-ing-ni] di-di.
write-rel-nml−2sg-acc] say-past.3
Tursun told Mehummet that you wrote a letter.

Whether or not the embedded clause is finite affects whether or not indexicals may shift inside them; the phenomenon occurs only in (34). As such, indexical shift is sensitive to the structure of the embedded clause.

We now have a clear picture of indexical-shift languages and a strong case for the shifty operator theory to describe them. I go on to compare English to these indexical-shift languages.

3   Application

To move forward with an application of these theories to English, I return to Santorio's claim that his puzzle-structure generalises across different modals and different indexicals. Here is another Santorio-style puzzle that distinguishes itself from the first along these axes (modal and indexical):

> Upon discovering that you have arrived safely in Waterdeep, you attempt to cast the *sending* spell to magically communicate with your friend Nikolaus at home. You know that this spell also has a chance of failure, and your message may be sent instead to Nikolaus' sister, Adelheid. You craft your message thus:

> (36)   I know that either the spell succeeded and you are Nikolaus, or the spell failed and you are Adelheid.

> And once again you succeed! Nikolaus hears your message and derives its truth-conditions under a Kaplan-style semantics (remembering not to fall into the trap of analysing it under a material conditional analysis like (11)).

The conditions for (36) that Nikolaus decides on are:

$[\![x \text{ knows } p]\!]^{\varsigma\,i} = 1$ iff $\forall\, w'$ compatible with what x knows in w_c, $w' \in [\![\, p\,]\!]^{\varsigma\,i}$

> (37) $[\![(36)]\!]^{\varsigma\,i} = 1$ iff $\forall\, w'$ compatible with what the speaker knows in w_c such that $w' \in [\![\text{The spell succeeded}]\!]^{\varsigma\,i}$, $w' \in [\![\text{ADDR}_c \text{ is Nikolaus}]\!]^{\varsigma\,i} \wedge \forall\, w'$ compatible with what the speaker knows in w_c such that $w' \in [\![\text{the spell failed}]\!]^{\varsigma\,i}$, $w' \in [\![\text{ADDR}_c \text{ is Adelheid}]\!]^{\varsigma\,i}$

Since ADDR$_c$ is in fact Nikolaus, he should then assume you think *the spell succeeded and Nikolaus is Nikolaus* has all along been just as likely as the obvious contradiction *the spell failed and Nikolaus is Adelheid*—you believe that one individual, in any possible world, could be either themselves or someone else, depending on the outcome of the spell. Nonsense! It is a different magic spell which accomplishes that feat. Therefore this is another example of what appears to be indexical shift in English, improperly captured by the Kaplan approach. I use it as the model for the following sections.

3.1 Puzzles and generalisations

We can compare the new puzzle to Deal's generalisations about indexical-shift languages:

I *Indexical shift is specific to speech and attitude reports.*

The model certainly contains an attitude report, under the predicate *know*; unlike in the cross-linguistic examples, it is not a case of a first-person pronoun referring to an attitude holder, but Deal's definition is not restricted to these. The conditional case in the prototypical Santorio puzzle, exemplified by (3) and (4), appears different; but it is argued by Santorio to contain an implicit belief-report as a consequence of the truth-conditions for *if* which rely on the speaker's epistemic state. A Santorio-style puzzle without an attitude report would necessarily look like (1) (repeated in (38) below), and this is the sort of construction Kaplan considered when writing on 'monsters'.

(38) #In the year 700$_1$, the country will now$_1$ be ruled by a count.

I have been unable to construct an example which is both 'monstrous' and without some form of attitude report; particularly because Santorio-style puzzles require a contradictory pair of conditional clauses, which carry an implicit belief-report under this analysis. This pattern—that finding a counterexample is the real difficulty—is to continue.

II *Indexical shift operates on a whole-clause basis.*

A slightly amended puzzle is necessary here. If English indexicals adhere to the Shift-Together Constraint, or some variant of it, we should expect that two indexicals of the appropriate types in the same "shifty" clause should both shift. The following is an adaptation of the model that presents this problem:

(39) I know that either the spell succeeded and you are Nikolaus and you are my friend; or the spell failed and you are Adelheid and you are my friend's sister.

Already the problem of finding a counterexample is evident, but a straightforward utterance with the same indexical twice at the same level of embedding appears to conform to the Constraint. Next, an utterance with two distinct indexicals, which requires some additional framing:

You endeavour to use your *teleport* spell to transport yourself to your friend's side, to confirm by eyewitness the individual by whom your messages are being received. You know that, at the present moment, Nikolaus is in the city of Wa-

terdeep and Adelheid is in the city of Baldur's Gate. After casting the spell, you once again find yourself in an urban setting, and hear approaching footsteps. You intuit that they belong either to your friend or his sister, and so you utter:

(40) If the spell succeeded, this is Waterdeep and you are Nikolaus. If the spell failed, this is Baldur's Gate and you are Adelheid.

It appears that two different indexicals are shifted by the modal as well. I therefore tentatively conclude that English indexicals adhere to the Shift-Together Constraint, until a falsifying example is found (see Section 4 "Analysis" below for some additional investigations which I found difficult to categorise under this generalisation or III).

III *Indexical shift behaviour distinguishes shifty indexicals from bindable anaphoric elements.*

In indexical-shift languages, this meant that we could have one indexical element embedded under multiple context-shifting operators, and the indexical would be forced to refer to the most local context, as the shifty operator would have overwritten the relevant features of higher scopes. If that fact about shifty operator theory applies to English, and if this generalisation applies, we should see in similar cases the same result:

Undeterred by its repeated unreliability, you elect to cast the same *sending* spell as previously, but this time with the intent of contacting your brother Ismark. To cast the spell, you will place two cards in front of you and turn over either one or the other. The cards determine who receives your spell; the selection of people from which the cards may choose a recipient depends on the success or failure of the casting. You know that if you fail to cast the spell, the cards will redirect your message to either your friend Nikolaus or his sister Adelheid. Even if you cast the spell successfully, you may still turn over the card that causes the message to be sent to your sister Ireena.

(41) If the spell succeeded, then you must be my sibling. In that case, if I chose the correct card, then you are Ismark; and if I chose the incorrect card, then you are Ireena.

(42) If the spell failed, then you are not my sibling. In that case, if I chose the correct card, then you are Nikolaus; and if I chose the incorrect card, then you are Adelheid.

Here we have several embedded modals that, under the Santorio approach, shift indexicals: *if* and *believe*. As this example is more structurally complicated than the others, we first confirm that these create the same infelicity under the Kaplan

approach. Let us suppose that the spell did in fact succeed, and you did in fact turn over the Ismark card.

(43) a. If the spell succeeded, Ismark is my sibling and: *continued in (44)*
b. #If the spell failed, Ismark is not my sibling and: *continued in (45)*

(44) a. ...if I chose the correct card, Ismark is Ismark.
b. #...I chose the incorrect card, Ismark is Ireena.

(45) a. #...if I chose the correct card, Ismark is Nikolaus.
b. #...if I chose the incorrect card, Ismark is Adelhaide.

Interpreting the utterances with an 'un-shifty' reading produces nonsense, as expected; so this is an appropriately formed Santorio-style puzzle. Under Deal's generalisation, we should expect that the indexical *you* in the embedded conditionals should determine its referent from the context created by those conditionals. It does seem to behave this way; if it did not, we would see a reading of (41) that resembled the one in (44), where the referent of the embedded *you* is the same as the one selected by the conditional *If the spell succeeded*. Not only does this behaviour conform to the expectations of Deal's generalisations, it also provides preliminary evidence for the success of shifty operator theory on English data.

IV *Indexical shift is sensitive to the structure of the embedded clause.*

This is difficult to test in English. We should expect that there exist embedded clauses which "block" indexical shift; under shifty operator theory, this would entail a clausal structure that blocked the presence of the shifty operator itself. Following the example of the Uyghur data, that may be non-finite clauses, but these appear to be structurally incompatible with Santorio-style puzzles:

(46) #If the spell succeeded, you being Nikolaus...

Other structures, like small clauses, do not block shift:

(47) If the spell succeeded, I think you Nikolaus.

(48) If the spell failed, I think you Adelheid.

It is possible that there do not exist embedded-clause structures which prevent English indexicals from shifting. If that is the case, it may be that English indexical shift does *not* conform to generalisation IV; or if it does, it does so in a way that is entirely opaque.

It seems from a preliminary analysis that English indexical shift patterns similarly to the 'confirmed' cases of Zazaki, Slave, Nez Perce, and the others—the 'indexical-

shift languages'. All Santorio-style puzzles constructed to date, at least, fall under the umbrella of Deal's four generalisations; and so I move forward with a demonstration about how shifty operators interact with the puzzles semantically.

3.2 Shifty operator theory

We know from Kaplan that English indexicals determine their referent directly from the context of an utterance; and that the context can be modelled as something like an n-ple of author, addressee, location, and time—the model that Kaplan proposes and Deal uses in her analysis of Nez Perce. We have seen that Santorio-style puzzles exhibit 'shifty' behaviour which is at least mostly in line with Deal's generalisations about indexical shift. The natural progression is to try applying shifty operator theory to English. We will use the puzzle in (36) and its associated initial truth-conditions (repeated below).

> (49) I know that either the spell succeeded and you are Nikolaus or the spell failed and you are Adelheid.

> $[\![(49)]\!]^{\varsigma\,i} = 1$ iff $\forall\,w'$ compatible with what the speaker knows in w_c such that $w' \in [\![\text{The spell succeeded}]\!]^{\varsigma\,i}$, $w' \in [\![\text{ADDR}_c \text{ is Nikolaus}]\!]^{\varsigma\,i} \wedge \forall\,w'$ compatible with what the speaker knows in w_c such that $w' \in [\![\text{the spell failed}]\!]^{\varsigma\,i}$, $w' \in [\![\text{ADDR}_c \text{ is Adelheid}]\!]^{\varsigma\,i}$

Next we construct an operator to serve our purposes. As we have found that the modals in Santorio-style puzzles fully overwrite their embedded contexts, we will use the same operator as in (19), OP$_\forall$, which overwrites every feature of a context with that of a circumstance.

> (50) a. $[\![\text{OP}_\forall\,p]\!]^{\varsigma\,i} = [\![p]\!]^{i\,i}$

We attach OP$_\forall$ to the 'shifty' clauses:

> (51) I know that either [OP$_\forall$ the spell succeeded and you are Nikolaus] or [OP$_\forall$ the spell failed and you are Adelheid.]

Define two convenient variables (equivalent to the two clauses operated upon in (51):

> $p = \forall\,w'$ compatible with what the speaker knows in w_c such that $w' \in [\![\text{The spell succeeded}]\!]^{\varsigma\,i}$, $w' \in [\![\text{ADDR}_c \text{ is Nikolaus}]\!]^{\varsigma\,i}$

> $q = \forall\,w'$ compatible with what the speaker knows in w_c such that $w' \in [\![\text{The spell failed}]\!]^{\varsigma\,j}$, $w' \in [\![\text{ADDR}_c \text{ is Adelheid}]\!]^{\varsigma\,j}$

And then perform the derivation, which proceeds much like the one sketched for (24), for each clause:

$$[\![(51)]\!]^{\varsigma,\,i} = 1 \text{ iff } [\![\text{OP}_\forall\, p\,]\!]^{\varsigma,\,i'} \wedge [\![\text{OP}_\forall\, q\,]\!]^{\varsigma,\,j'}$$

As the process is the same for p as for q, only p is shown below.

Monstrous Function Application, β Reduction, β Reduction
$$[\![\text{OP}_\forall\, p\,]\!]^{\varsigma,\,i'} = 1 \text{ iff } [\![\, p\,]\!]^{i',\,i'} = 1$$

By this point we have seen $\text{OP}_\forall$ behave as expected; indeed, as stated in its definition in (19). We may now see how its effects project to references to the variables it overwrites:

Lexicon
$[\![\, p\,]\!]^{i',\,i'} = \forall\, w'$ compatible with what the speaker knows in $w_{i'}$ such that $w' \in$ $[\![\text{The spell succeeded}]\!]^{i',\,i'}$, $w' \in [\![\text{ADDR}_{i'}\text{ is Nikolaus}]\!]^{i',\,i'}$

The outcome is clear by this stage. c has been overwritten by i throughout, leaving w_c and ADDR_c pointing to the local circumstance, rather than the global context. For completion's sake, here are the full truth-conditions after deriving them for both clauses (note the prime and double-prime index parameters):

Result
$[\![(51)]\!]^{\varsigma,\,i} = 1$ iff $\forall\, w'$ compatible with what the speaker knows in $w_{i'}$ such that w' $\in [\![\text{The spell succeeded}]\!]^{i',\,i'}$, $w' \in [\![\text{ADDR}_{i'}\text{ is Nikolaus}]\!]^{i',\,i'} \wedge \forall\, w'$ compatible with what the speaker knows in $w_{i''}$ such that $w' \in [\![\text{The spell failed}]\!]^{j',\,j'}$, $w' \in [\![\text{ADDR}_{j'}$ is Adelheid$]\!]^{j',\,j'}$

The result is an assertion that, based on the speaker's knowledge in the world of each embedded circumstance, the addressee *in that circumstance* is Nikolaus, and the addressee in the other circumstance is Adelheid. We no longer see one ADDR_c attempting to map its equivalence to two different individuals. This is possible because each clause is given its own context and index parameter (different context parameters are not distinguished as they are either identical or the differences are irrelevant).

It appears we have met the requirements; at least, we have done in English what was done in Nez Perce by Deal (2020). I continue with this model into an analysis of the outcome and its implications.

4   Analysis

Straightforwardly, shifty operator theory makes the correct predictions with regards to Santorio-style puzzles in their strictest definition: pairs of modal-conditional embeddings with contradictory consequents depending on the world of evaluation. We have seen examples with a variety of modals and a variety of indexicals, as well as

several variations on the type of embedded clause or number of sub-clauses. In the section that follows, I consider why Santorio-style puzzles permit indexical shift, how effective the shifty operators are on English data, and the potential consequences of the operators' use; and I discuss some comparable phenomena.

4.1   Licensing shifty operators

In Slave, Anand & Nevins (2004) suggest lexical entries for indexical-shifting predicates that include the relevant shifty operator:

(52)   (Anand & Nevins, 2004, p. 32)

Verb	Lexical entries	Class description
TELL	[tell (OP$_{pers}$)]	optionally shifts all person indexicals
WANT	[want (OP$_{auth}$)]	optionally shifts all first-person indexicals
SAY	[say OP$_{auth}$]	obligatorily shifts all person indexicals

We might suggest something similar for the shifty interpretation of English conditionals. In the demonstration above, OP was attached to the clauses embedded under epistemic quantifiers, and so following the Slave example we might say that a lexical entry for English *know* (or any of a number of similar attitude-report predicates) looks something like:

(53)   KNOW: [know (OP$_\forall$)] (optionally shifts all indexicals)

However, this entry makes incorrect predictions in non-Santorio-style-puzzle cases. Under the assumption in (53), the following utterance should be ambiguous:

(54)   #I know that in 2008 there will be a financial crisis now.

Much like in (17) where WANT optionally shifts first-person indexicals embedded beneath it, leading to two-way ambiguity of the first-person pronoun in the utterance, *now* in (54) ought to be ambiguous between the t_c (the 'time' feature of the utterance context) and the year 2008. Instead, it is inappropriate to utter at all: shift of *now* is not licensed and we see it 'leap out', as Kaplan said, producing an internal contradiction. Therefore the lexical entry in (53) is insufficient.

Based on the stated construction of Santorio-style puzzles, OP should rather appear as part of conditionals:

$[\![\text{if } p, q]\!]^{c,i,g} = 1$ iff $[\text{OP}_\forall \, \forall \, w'$ compatible with what the speaker knows in w_c such that $w' \in [\![p]\!]^{c,i,g}$, $w' \in [\![q]\!]^{c,i,g}]$

This is the assumption under which the derivation in Section 3.2 was performed, and it successfully predicts basic indexical shift outcomes. Based on the interaction of English indexicals with the Shift-Together Constraint and observations made about shift throughout the various examples in this paper, it appears that OP∀ specifically is the appropriate operator to include in the lexical entry. Can we then conclude that, in English, the appropriate analysis of conditionals is the one from Stalnaker (1968) and the operator from Anand & Nevins (2004) concatenated? It first remains to be seen whether or not adopting such an analysis makes any wrong predictions in other domains.

4.2 Monstrous consequences

The first issue shifty operators may present is when two kinds of indexical appear in the same clause. We have seen that in some languages, the operator is designed to only affect certain kinds of indexical by only overwriting certain features of the context; but the analysis of Santorio-style puzzles used earlier supposes they contain an OP∀, overwriting every feature of the context with those of the circumstance. It is ultimately desired behaviour, then, that the operator shifts all embedded indexicals equally: it is merely adherence to the Shift-Together Constraint. A concern might arise if a Santorio-style puzzle contained two embedded indexicals that should not be predicted to both shift *and* still adhered to the Constraint (by, for example, being of different types); but as discussed in Section 3.1 I have as yet been unable to construct one. There is another area where the operators may have impact which is of greater concern.

An advantage of shifty operators is that they do not affect the content of the index parameter, allowing other domains that typically rely on that information to continue to access it without issue. A disadvantage is that they greatly affect the content of the context parameter, leaving facts about the 'real world' irrecoverable. Indexicals deeper in the embedding-structure can never, as Kaplan put it, "leap out", once the context has been overwritten. Just as in the case of two indexicals in the same clause, this may be desirable: it certainly seems that Santorio-style puzzles create entirely new contexts that share nothing in common with the 'real world'. Fortunately, the context parameter is more or less dedicated to the evaluation of indexicals, and the only impact this may have is on other, later theories. If it became necessary to access information about an utterance's context for the evaluation of some other semantic element in the future, shifty operators may prove inappropriate; they are ultimately a particularly destructive approach.

4.3 Phenomenal miscellany

There are several phenomena which have some relation to the puzzles and English indexical shift. One of these is modal subordination—Santorio-style puzzles are easily adapted to a form which produces it—and the remainder, including a comparison

with the original Santorio (2010), are grouped together in an effort to consolidate indications towards further research.

4.3.1 Modal subordination

There is some overlap in between the structure of Santorio-style puzzles and typical cases of modal subordination. This section lacks any particularly robust theoretical discussion, but the examples within highlight why it is insufficient to consider merely the 'standard' form of Santorio-style puzzles. We can construct a puzzle that highlights the similarities:

(55) If the spell succeeded, you are Nikolaus. You are my friend.

(56) If the spell failed, you are Adelheid. You are my friend's sister.

Just as in a straightforward example of modal subordination (*A wolf might get in. It would eat you first!* (Roberts, 2020, p. 1)), the subject *you* is evaluated as referring to an individual in the circumstance created by the modal despite not being syntactically dependent on it. This creates some difficulty for shifty operator theory: the second *you* in (55) ought to refer to the addressee of its own clause's context parameter, rather than the one operated on by the OP$_v$ attached to the first clause. However, since we have tentatively decided that the operator attaches to the modal itself, an account of modal subordination which allows elements in the second clause to be evaluated through the semantic properties of the modal in the first clause should make the correct predictions about indexical referents in cases like (55) and (56). Further analysis, particularly syntactic analysis, is required to determine how exactly these mechanisms interact and what bearing modal subordination analyses have on the interpretation of indexicals in this environment.

4.3.2 Related accounts

Santorio (2010), the paper from which the puzzles discussed in this dissertation derive, largely concerns the author's own theory of indexical shift in English. While I have not set out to discuss that theory in depth, a few words comparing the two are in order. Both shifty operator theory and Santorio's are "monstrous theories" (Santorio, 2010, p. 291), as opposed to an approach by Percus & Sauerland (2003) which remains more in line with Kaplan's original Principles. Santorio's approach foregoes modifying the index parameter in favour of introducing a bespoke assignment *a* through which indexicals determine referent. The similarity between these "monstrous theories" is that both accept modals as context-shifting operators. Shifty operator theory does so by including an additional operator in the lexical entry of the modals, while Santorio's theory adjusts the quantification of the modals to affect both the new assignment *a* and possible worlds. Ultimately, both theories permit modals to modify the function through which indexicals determine referent, rather

than changing the behaviour of the indexicals themselves; this is what makes the theories "monstrous".

Both these theories stand opposed to the Kaplan-style account proposed in Percus & Sauerland (2003), which makes use of CONCEPT GENERATORS to correctly assign intensions to indexicals. Concept generators are functions given as arguments to modals which accept individuals denoted by indexicals and themselves produce functions that generate appropriate intensions. Concept generators are similar to, and indeed mentioned by, the theory described in Anand & Nevins (2004) and Deal (2020). Both involve embedding a new function in the lexical entries of modals; though, concept generators are merely passed as arguments to modals and therefore do not transform them into true monsters. Deal leans on concept generators to recover certain *de re* readings from Nez Perce utterances (Deal, 2020, p. 25), demonstrating that, at least in that language, the two theories are compatible. A complete picture of the various accounts of English indexical shift is not the subject of this paper, but it warrants mention that there is yet no agreed-upon theory.

4.4 Conclusions

Indexical shift in English patterns like it does in 'indexical-shift languages', such as Zazaki, Slave, and Nez Perce, at least in the case of Santorio-style puzzles. These are pairs of utterances containing modals, conditionals, and indexicals which, when taken together under a Kaplan-style semantic analysis, appear contradictory despite the *prima facie* truth of both. The apparent contradiction is the fault of the embedded indexicals, and can be resolved by allowing them to shift as part of a process deemed "monstrous" by Kaplan. Their shift conforms to a cross-linguistic pattern of generalisations identified by Deal (2020), and can be semantically accounted for by the introduction of the "shifty operators" conjectured by Anand & Nevins (2004) to the lexical entries of the conditionals responsible. Specifically, all indexicals embedded in the Santorio-style puzzles are made to shift, so an OP$_\forall$ constructed according to the methods of those authors makes the correct predictions about the interpretation of the utterances. It remains to be seen whether that operator is equally successful at describing occurrences of indexical shift in English environments besides Santorio-style puzzles.

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