Which logic for iteratives?

Fabien Schang

LHSP Henri Poincaré
Université de Lorraine, Nancy

Moscow State University, Moscow

schang.fabien@voila.fr

Content

1. What are iterative verbs?

2. One case in point: doubting

3. Iteration and illocution

4. Conclusion: positive vs. negative iterations

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What are iterative verbs?

Definition

"Iterative": that which occurs repeatedly and applies to oneself
(differs from the linguistic sense of a repeated action: hop, cough, etc.)

Modal logics: ontic, temporal, epistemic (+ boulic) (GARDIÈS 1979)
Multimodal logics: "it will be the case that you know that I ought …"

Logical meaning of iterations: functions of functions $f_1(f_2(\ldots f_n(p)\ldots))$
Modal systems including iteratives X:
S4: $X(p) \rightarrow X(X(p))$
S5: $\sim X(p) \rightarrow X\sim X(p)$

To what extent does the iteration of a verb make sense?
Suggested list: believe, know, doubt, think, want, fear, remember, forget, desire, refuse
… propositional attitudes, psychological verbs
Epistemic logic: theorem of positive introspection S4
$K_a p \rightarrow K_a K_a p$ (if *a* knows that p, then *a* knows that *a* knows that p)
Boulic logic (desire, hope, want): I want that I want that p/I want to want that p (be the case); I desire to desire that p (be the le cas); I hope to hope that p (be the case)

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Grammatical/logical distinctions

- indicative (factive) / subjunctive (hypothetical)

factives assume the truth of the sentential content (know, remember)
hypotheticals are about unreal facts (believe, want, hope, fear, doubt)

I fear that I would fear that p = I fear to fear that p
Multi-agents logics: I know that you know, I want you to know

- that / whether

not to know that/not to know whether; to doubt that/to doubt whether; not to remember that/not to remember whether
(--- that: factive presupposition, *neg-raising* aspect of negative verbs)
"I don't know *that* p" presupposes that p is true (not to know that p □ p is true)
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Logical difference (in English): that / whether
I doubt that/whether you will be there tomorrow
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- that / to

I forget *that* I forget that today is Saturday / I forget *to* forget that today is Saturday
= I forget to forget the peculiarity of the present day (RUSSELL's propositional concept, reducible to a *that*-clause "I forget that ...")
= propositional concept and that-clause express a *proposition* (difference: the proposition is asserted, or not), whatever their grammatical mode may be

- personal pronouns

the kind of personal pronoun may determine the meaning of the iteration
He does not know that he knows that p: consistent
I do not know that I know that p: absurd

Note: these two examples are not *proper* iterations (S4-formulas)
- he does not know that he knows / I do not know that I know (Moore's Paradox)
positive iteration: I know that I know, he knows that he knows, we know that we know ... the same meaning, consistent
negative iteration: I do not know that I do not know, he does not know that he does not know, we do not know that we do not know ... variable meanings

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positive iteration: I know that I know, he knows that he knows, we know that we know ... the same meaning, consistent
negative iteration: I do not know that I do not know, he does not know that he does not know, we do not know that we do not know ... variable meanings

- that / to

I forget *that* I forget that today is Saturday / I forget *to* forget that today is Saturday
= I forget to forget the peculiarity of the present day (RUSSELL's propositional concept, reducible to a *that*-clause "I forget that ...")
= propositional concept and that-clause express a *proposition* (difference: the proposition is asserted, or not), whatever their grammatical mode may be

- personal pronouns

the kind of personal pronoun may determine the meaning of the iteration
He does not know that he knows that p: consistent
I do not know that I know that p: absurd

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Thesis: iteration and illocution

Iteration: a psychological attitude submitted to conversational rules
(1) iteration is redundant ($Xp \rightarrow XXp$ is a theorem) iff:
- it is positive
- the pronoun entails an illocutionary relation between the speaker and the hearer (I, you, we)

(2) iteration is self-contradictory ($Xp \rightarrow \sim XXp$ is a theorem) iff:
- it is negative
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(3) iteration is contingent in every other case.

(4) the success-conditions of iteratives refer to two special acts:
- the success-conditions of assertive acts
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By extension: I affirm that I affirm ..., I say that I say that ..., etc.
speech-acts = public expressions of mental states (thoughts)

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Logical analysis of iteratives

An iterative is negative if it can be reduced to a negative propositional attitude
2 examples: doubt, forget
(symbols: D: doubt; K: know; B: believe; F: forget; R: remember)

Triangle of contraries

Bp / Kp B~p / K~p Rp R~p

Dp

$Dp \rightarrow \sim(Kp/Bp)$
$Dp \rightarrow \sim(K\sim p/B\sim p)$
$Dp \rightarrow (\sim Kp/\sim Bp \wedge \sim K\sim p/\sim B\sim p)$

Fp

$Fp \rightarrow \sim(Rp)$
$Fp \rightarrow \sim(R\sim p)$
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These verbs relate to conscious processes … (about thought, generally speaking)
What is thinking? Doubting, to wanting, feeling (DESCARTES 1990): case of doubt

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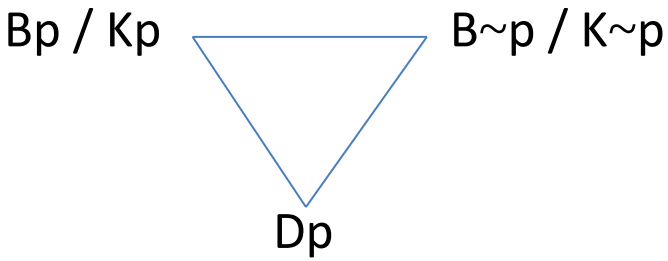

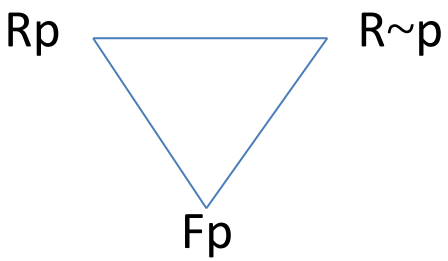

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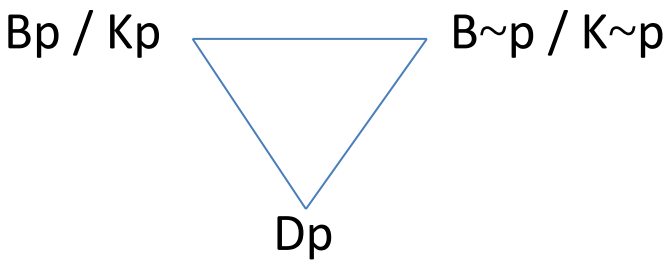

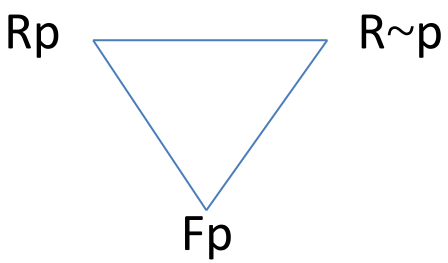

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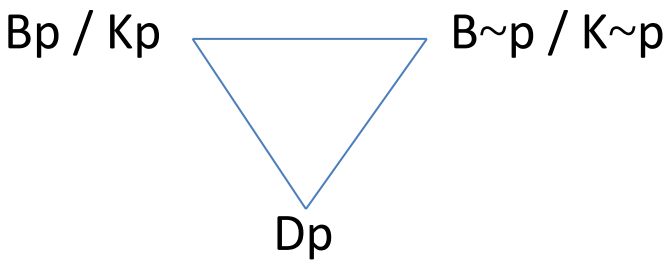

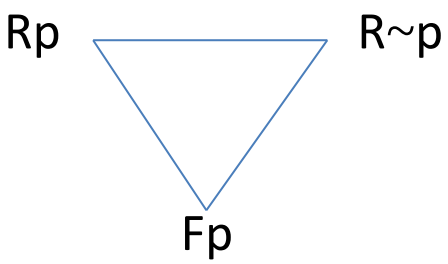

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2.
One case in point: doubting

Definition of doubt

But what, then, am I? A thinking thing, it has been said. But what is a thinking thing? It is a thing that doubts, understands, [conceives], affirms, denies, wills, refuses; that imagines also, and perceives.
(DESCARTES 1990: 63)

Thought acts

Positive	**Negative**
conceiving	doubting
affirming	denying
wanting	refusing
imagining	
perceiving	

In doubt, the mind vacillates, cannot choose any one of the incompatible predicates, sentences or attitudes, and come to rest.
(SIBAJIBAN 1963: 107)

Formalization: $Dp \leftrightarrow (\sim Bp \wedge \sim B\sim p)$

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But what, then, am I? A thinking thing, it has been said. But what is a thinking thing? It is a thing that doubts, understands, [conceives], affirms, denies, wills, refuses; that imagines also, and perceives.
(DESCARTES 1990: 63)

Thought acts

Positive	**Negative**
conceiving	doubting
affirming	denying
wanting	refusing
imagining	
perceiving	

In doubt, the mind vacillates, cannot choose any one of the incompatible predicates, sentences or attitudes, and come to rest.
(SIBAJIBAN 1963: 107)

Formalization: $Dp \leftrightarrow (\sim Bp \wedge \sim B\sim p)$

Doubting / ignoring

Doubt entails ignorance: $D \rightarrow \sim K$
Which sense of ignorance?

- objective: lack of evidence (D_1)

doubting: lacking evidence, ignoring
I doubt that I doubt that p: I lack evidence that I lack evidence that p
D_1p does not entail $D_1(D_1p)$
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- cf. impossibility proof (GÖDEL's incompleteness, Neo-Academician skepticism)
- iteration of D_1: $D_1p \rightarrow D_1D_1p$ is contingent

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- X(p): the attitude X is about the sentential content p (1^{st} order)

Example: doubting *that which* one doubts, i.e. the sentential content p

- X(X(p)): the attitude X is about the attitude X related to p (2^{nd} order)

Example: doubting one's doubt about p

- iteration of knowledge

2 interpretations of the theorem of negative introspection (IN): $\sim Kp \rightarrow K\sim Kp$

- I don't know everything I ignore (p): (IN) is contingent
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- iteration of doubt

argument for the contingency of iterated doubt: $\sim(Dp \rightarrow DDp) \wedge \sim(Dp \rightarrow \sim DDp)$

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Proof of contradiction for iterated doubt

(1)	$Dp \leftrightarrow (\sim Kp \wedge \sim K\sim p)$	Df. D/~K
(2)	$Dp \leftrightarrow (\sim Bp \wedge \sim B\sim p)$	Df. D/~B
(3)	$Bp \leftrightarrow \sim B\sim p$	seriality
(4)	$Kp \rightarrow p$	reflexivity
(5)	$DDp \rightarrow \sim BDp$	(2), subst. [Dp/p]
(6)	$\sim BDp \rightarrow B\sim Dp$	(3), subst. [Dp/p]
(7)	$B\sim Dp \rightarrow (BKp \vee BK\sim p)$	(1), de Morgan
(8)	$(BKp \vee BK\sim p) \rightarrow (Bp \vee B\sim p)$	(4)
(9)	$(Bp \vee B\sim p) \rightarrow \sim Dp$	(2), contraposition
(10)	$(BKp \vee BK\sim p) \rightarrow \sim Dp$	(8)-(9), detachment
(11)	$DDp \rightarrow \sim Dp$	(5)-(10), détachement
(12)	$Dp \rightarrow \sim DDp$	(11), contraposition

Conclusion:
- if I believe that I know whether p, then I do not doubt p (10)
- if I doubt p, then I do not doubt my doubt about p (12)
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(2)	$Dp \leftrightarrow (\sim Bp \wedge \sim B\sim p)$	Df. D/~B
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(4)	$Kp \rightarrow p$	reflexivity
(5)	$DDp \rightarrow \sim BDp$	(2), subst. [Dp/p]
(6)	$\sim BDp \rightarrow B\sim Dp$	(3), subst. [Dp/p]
(7)	$B\sim Dp \rightarrow (BKp \vee BK\sim p)$	(1), de Morgan
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- one may not believe without doubting: a duck does believe neither that Salvador Dali was crazy nor that he was a genius

- doubt presupposes a consideration (*Annahme*) of the sentential content:
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- thinking is believing

$Dp \leftrightarrow B(\sim Bp \wedge \sim B \sim p)$

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$DDp \leftrightarrow B(\sim B \sim Bp \vee \sim B \sim p) \wedge \sim B(B \sim B \sim p \wedge B \sim Bp)$ ...

- FREGE makes a distinction between consideration (p) and judgment (|- p)
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HART's definition can be questioned itself

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if I doubt p, then I consider p

- thinking is believing
Dp $\leftrightarrow$ B(~Bp $\wedge$ ~B~p)

- 2 problems:

- does the iteration of doubt make sense?
DDp $\leftrightarrow$ B(~B~Bp $\vee$ ~B~p) $\wedge$ ~B(B~B~p $\wedge$ B~Bp) …

- FREGE makes a distinction between consideration (p) and judgment (|- p)
I may consider p without believing that p is (not) the case
HART's definition can be questioned itself

Solution: an illocutionary analysis of doubt

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Objection: against the universality of the Cartesian doubt

To see why the Cartesians hold [that doubt cannot be doubted] let us analyze their argument. They assert that whenever a doubt is doubted, we are necessarily left with a doubt. For let us say that a doubt is doubted; but this can be done only by another doubt, and this doubt is asserted. So doubt can be doubted only through the assertion of doubt.
(SIBAJIBAN 1963: 84)

Explanation:
- the Cartesian (methodological) doubt is universal (no distinction D_n / D_{n+1})
doubting doubt and doubted doubt are the same doubt: for every *n*, $D_n = D_{n+1}$
- therefore doubt is never doubted itself: it is certain (asserted)
no proof of redundancy for doubt: $Dp \rightarrow DDp$ (to the contrary!)
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If doubt is never doubted (universal), then the subject is certain about her/his doubt
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iterated doubt is contingent, assuming the variety of doubts

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A performatory interpretation of the Cartesian *cogito*

The statement of universal doubt is expressed by means of an assertion:
- the *cogito* proof is not an inference, but a performance (HINTIKKA 1985)
- "I *walk*, therefore I am" is not a logically valid sentence
- "I *think*, therefore I am" is a self-evident utterance

cogito, ergo sum: I affirm that if I think then I exist

Sentence/Proposition	**Utterance**
I think, therefore I am	"I exist"
I think, and I don't exist	"I don't exist"
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3.
Iteration and illocution

Locutionary paradoxes, or illocutionary paralogisms?

For any sentence p, its utterance “p” yields a statement such that Xp ⊣ A(Xp)
“I know that p” = A(Kp)
“I doubt p” = A(Dp)

A subjective interpretation of knowledge supports the theorem of positive introspection:
“I know that p”: I affirm that I know that p
A = K, Kp ⟶ KKp

FITCH's and MOORE's Paradoxes: illocutionary paralogisms (SCHANG 2011)

Théorème 1. *Theorem 1. If α is a truth class which is closed with respect to conjunction elimination, then the proposition, [p ∧ (αp)], which asserts that p is true but not a member of (where p is any proposition), is itself necessarily not a member of α.*
(FITCH 1963: 138)

Truth class: {B,K,T,A}∈ *α*
B: belief, K: knowledge, T: truth (statement), A: affirmation

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FITCH's and MOORE's Paradoxes: illocutionary paralogisms (SCHANG 2011)

Theorem 1. If α is a truth class which is closed with respect to conjunction elimination, then the proposition, [p ∧ (αp)], which asserts that p is true but not a member of (where p is any proposition), is itself necessarily not a member of α.
(FITCH 1963: 138)

Truth class: $\{B,K,T,A\} \in \alpha$
B: belief, K: knowledge, T: truth (statement), A: affirmation

Locutionary paradoxes, or illocutionary paralogisms?

For any sentence p, its utterance “p” yields a statement such that Xp = A(Xp)
“I know that p” = A(Kp)
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A subjective interpretation of knowledge supports the theorem of positive introspection:
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"p, and $\sim\alpha$p" = B(p $\wedge$ ~Bp) MOORE's Paradox

(1) I forget that I forget that my train leaves at 7pm
(2) He forgets that he forgets that his train leaves at 7pm
Difference: (1) is absurd, (2) is not
(1) is a counterpart of MOORE's Paradox
"It is (not) raining, but I (don't) believe that it is raining."

"It is raining, but he does not believe that it is raining" is not absurd
Any variant of MOORE's Paradox is consistent only if *x* is not a pronoun of the 1st or 2nd person: (a) p $\wedge$ ~B_xp, (b) ~p $\wedge$ B_xp

Explanation: Moorean sentences are utterances performed by a speaker
- this speaker is aware of the sentential content of her/his utterance
- any utterance violating the preconditions of an utterance act is absurd
Preconditions:
- the speaker believes what (s)he says (sincerity clause)
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“p, and ~α p” = K(p $\wedge$ ~Kp) FITCH's Paradox

Paradox of knowability: (PC) p $\rightarrow$ $\Diamond$Kp

(1)	(p $\wedge$ ~Kp)	Premise
(2)	(p $\wedge$ ~Kp) $\rightarrow$ K(p $\wedge$ ~Kp)	(1), (PC)
(3)	(p $\wedge$ ~Kp) $\rightarrow$ $\Diamond$(Kp $\wedge$ K~Kp)	(2), modal distribution
(4)	(p $\wedge$ ~Kp) $\rightarrow$ $\Diamond$(Kp $\wedge$ ~Kp)	(3), reflexivity
(5)	(p $\wedge$ ~Kp) $\rightarrow$ $\Diamond$($\bot$)	(4)
(6)	~(p $\wedge$ ~Kp)	(5) refutation *ad absurdum*
(7)	p $\rightarrow$ Kp	(6) Df. ~$\wedge$ / $\rightarrow$

The premise of non-omniscience is the culprit: p ? ~Kp
- a consistent sentence: there are unknown truths (p)
- an absurd utterance: an antirealist cannot affirm a truth (p) without proof
cannot ignore the truth of a sentence (s)he just asserted

(ex: p = “my train leaves at 7pm, but I don't know that my train leaves at 7pm”)

“p $\wedge$ ~Kp = K(p $\wedge$ ~Kp) = Kp $\wedge$ K~Kp = Kp $\wedge$ ~Kp = $\bot$

FITCH's Paradox is dissolved in its illocutionary version: the premise is indefensible

“p, and $\sim_{\alpha}$ p” = $K(p \wedge \sim Kp)$ FITCH's Paradox

Paradox of knowability: (PC) $p \rightarrow \Diamond Kp$

(1) $(p \wedge \sim Kp)$ Premise
(2) $(p \wedge \sim Kp) \rightarrow K(p \wedge \sim Kp)$ (1), (PC)
(3) $(p \wedge \sim Kp) \rightarrow \Diamond(Kp \wedge K\sim Kp)$ (2), modal distribution
(4) $(p \wedge \sim Kp) \rightarrow \Diamond(Kp \wedge \sim Kp)$ (3), reflexivity
(5) $(p \wedge \sim Kp) \rightarrow \Diamond(\bot)$ (4)
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The premise of non-omniscience is the culprit: p ? ~Kp
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FITCH's Paradox is dissolved in its illocutionary version: the premise is indefensible

“p, and $\sim_{\alpha}$ p” = $K(p \wedge \sim Kp)$ FITCH's Paradox

Paradox of knowability: (PC) $p \rightarrow \Diamond Kp$

(1)	$(p \wedge \sim Kp)$	Premise
(2)	$(p \wedge \sim Kp) \rightarrow \Diamond K(p \wedge \sim Kp)$	(1), (PC)
(3)	$(p \wedge \sim Kp) \rightarrow \Diamond(Kp \wedge K\sim Kp)$	(2), modal distribution
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Any iterative reducible to a conscious act can be expressed by a speech-act and obeys the illocutionary logic of assertives
remembering, knowing: conscious acts related to a sentential content

Truth clause: for any iterative verb X
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Example: forgetting
- the sentence "I forget that my train leaves at 7pm" is illocutionarily contradictory
I believe that I forget that my train leaves at 7pm, therefore I don't forget that I forget that my train leaves at 7pm

The success-conditions of this sentence are incompatible with its assertion: one cannot forget what one is uttering (talking about)

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Objection: is any utterance an assertive act?

- 5 classes of illocutionary force (and degrees of strength) for utterances (SEARLE 1969)
examples: asserting, surmising, supposing, believing, fearing, hoping
- fearing, hoping, believing, etc. are not assertive, but expressive acts: different success-conditions, therefore different iteration rules?

fearing: hoping that not
Cp = E~p
forgetting: not remembering
Op = ~Rp

Reply:
- the basic performatory acts are assertives
- an iteration is contradictory if it denies the assertive act (ex: doubting, forgetting)
for instance, iterated fears or hopes are not contradictory
fearing = not hoping, and not hoping p is not opposed to the act of asserting p
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4.

Conclusion:
positive *vs* negative iterations

Can skeptical doubt be expressed?

Difference between doubt and denial
- doubt: asserted disbelief
- denial: non-assertion

PARSONS 1984: "I don't assert this sentence" is not contradictory
difference with the Liar Paradox: "this sentence is not true" = I assert that this sentence is not true
self-contradiction of self-referential sentences: when asserted
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JOHANSSON 1987: *performative* contradictions
APEL 1994: pragmatic self-contradiction (transcendental pragmatics)

Iteratives correspond to conscious acts; if conscious acts correspond to assertives, then iteratives correspond to assertives
- assertives obey a logic of speech-acts, in the illocutionary version
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Denials of conscious acts undermine assertions: they defeat the purpose of telling truth about a conscious act by means of an affirmative proposition

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- doubting one's doubt: partition of consciousness, no identity of the thinking subject

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- Logical analysis of iterations

$Xp \longrightarrow XXp$

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- both operations are on a par to avoid infinite regression:

if $Xp \longrightarrow XXp$ and $\sim(XXp \longrightarrow Xp)$, then $Xp \longrightarrow X_np$ is undecidable (when $n > 1$)

- any iteration of X is reducible iff X is redundant or contradictory
is not reducible, otherwise

I know that I know that … I know that p: reducible to first-order knowledge

I doubt that I doubt that … I doubt that p: redundant if *n* is odd
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I don't think that I don't think

I care to care
I don't care not to care

I regret to regret
I don't regret not to regret

I forget that I forget
I don't forget that I don't forget

I doubt that I doubt
I don't doubt that I don't doubt

I refuse to refuse
I don't refuse not to refuse ...

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