

Annotations¹

- A1** :1:189 «...Put in a description of why this section has been included (e.g., see A8 and 1st ¶ on 174; and warn the reader away from the technical stuff at the beginning...»

«...from pp. 377–392 »

Perhaps refer to ·8/1: “The concepts of dynamic and static scoping, however, are by and large described in the literature in terms of *mechanisms* and/or behavior: one protocol is treated this way; the other that. It is not my policy, in this entire exercise, to accept behavioral accounts as explanations. Throughout, I am committed to being able to answer such questions as “*Why* do these scoping regimens behave the way that they do?” and “*Why* was static scoping used in 2Lisp and 3Lisp?””

Cf. also: “it might be tempting to say something like the following: that LAMBDA is an [intensional] function from *textual objects* (the body expression and so forth) onto the *intension* of those textual objects in the context in force at the time of reduction”

Cf. also: “What do LAMBDA terms *mean*?”

- A2** :1/1/3:5 It is true that atoms designate the referent of the expression to which they are bound, but the normative relation of φ and ψ would have been more clearly expressed if the sentence had been written: “they are bound to normal-form designators of their referents.”

- A3** :1/2 As stated in the Introduction to the dissertation (ch. 3b), Σ is a *general significance function* that specifies both the co-constituted declarative import (φ) and procedural consequence (ψ) of computational structures. If s is the set (or type) of internal structural elements,² ENVS of environments, FIELDS of structural field states,³ and CONTS of continuations, then, as defined in dissertations chapters 2 and 3:

$$\begin{aligned}\varphi &: [[\text{ENVS} \times \text{FIELDS}] \rightarrow [s \rightarrow D]] \\ \psi &: [[\text{ENVS} \times \text{FIELDS}] \rightarrow [s \rightarrow S]] \\ \text{CONTS} &: [[s \times \text{ENVS} \times \text{FIELDS}] \rightarrow [s \times \text{ENVS} \times \text{FIELDS}]] \\ \Sigma &: [[s \times \text{ENVS} \times \text{FIELDS} \times \text{CONTS}] \rightarrow [s \times \text{ENVS} \times \text{FIELDS}]]\end{aligned}$$

1. References are in the form *page/paragraph/line*; with ranges (of any type) indicated as *x:y*. For details see the explanation on p.

2. What in «where?» I call *impressions*.

3. I.e., a determination of all facts pertaining to issues that are amenable to side-effects, such as the elements of all pairs and rails.

3.5. By ‘redex’ I mean what is referred to with “reduction (pair)” in the subsequent sentence. I would done better to use ‘redex’ throughout the dissertation.

- A4** .1/3/1 In the original dissertation the equations in this section were numbered s4-430 through s4-459. For this version, for convenience, I have renumbered them 1-30.
- A5** .2/0/4 By the phrases “ λ -term” and “LAMBDA-term,” throughout this section, I do not mean the singleton term ‘ λ ’ or ‘LAMBDA’, but rather what it would have been better to call a “ λ -redex” (or “LAMBDA-redex”)—i.e., *composite* function-designating term of the form ‘ $\lambda v . \text{expression}$ ’ in the λ -calculus or ‘(LAMBDA TYPE PATTERN BODY)’ in 2Lisp. (Thus the statement: “a λ -term is a *complex expression*....”)
- In general, I use the version “ λ -term” both for such redexes specifically in the λ -calculus or when I wish to refer to instances of both kinds, and “LAMBDA-term” when making specific reference to these structures in 2Lisp.
- A6** .4/3/1 As had been explained in an earlier (dissertation) chapter, in transcribing interactive 2Lisp sessions, I used ‘>’ as a prompt (before both input and output), and italics to signal user input. In addition (see example [13]) output explicitly requested by user programs (e.g., through uses of PRINT) is underlined.
- A7** .4/-2 The fact that LAMBDA, EXPR, IF, etc., can all be passed around as straightforward function designators, rather than having to be treated as special cases, or even as keywords (effectively: syntactic marks), illustrates the point made in annotation A....: that what in normal languages and logics are considered *intensional contexts* are in 2/3Lisp taken to be perfectly ordinary transparent, extensional contexts, processed (i.e. “used”) at a different level.
- A8** .4/-1 This paragraph is somewhat disingenuous. It is of course true that the procedural consequence of LAMBDA-terms does not arise from the *name* ‘LAMBDA’, though it is definitely associated with the primitive LAMBDA closure. What I believe I meant, though, is that the specific procedural consequence of normalising a LAMBDA term (i.e., a LAMBDA redex) has to do with facts about the body. Specifically, as I explain later in the text, the procedural mandate on LAMBDA redexes is that, when normalised, they need to *preserve the intension* of the body expression.
- A9** .5/5/-2 As explained more clearly in the paragraph following example [14], in saying “the behavior of the resultant procedure *when it is used*” (emphasis added), I mean when the procedure defined or named by

the lambda term is subsequently, as it is said, “applied.”

A10 .9/0/4:5 Saying that LAMBDA is “a function from textual objects onto functions” was both ambiguous and incorrect.

The ambiguity has to do with the range: I meant that the range of LAMBDA is the *set of functions whose intensions we are currently discussing*; the range is not those intensions themselves.⁴

The error is in the description of the domain. LAMBDA is not (i.e., the term ‘LAMBDA’ does not designate) a function *from textual objects* onto anything. Rather, LAMBDA is approximately an *intensional identity function*. Extensionally, it maps intensions onto themselves; hyper-intensionally (i.e., in terms of the arguments supplied in the redex, *qua* structures, and the structures yielded by reducing that redex), it takes what is in all likelihood will be a *context-dependent function designator*, and produces a normal-form (i.e., contextually-independent) designator of that function. On a conception of intension that is insensitive to lexical forms of context-dependence, that is, the result of the reduction is a function designator that is both *extensionally and intensionally* equivalent to the original argument. This characterization is much more accurately captured in the subsequent τ_3 (.183/4).

Cf. annotation A11, below, and the discussions of intensions, and of layered notions of context-dependence (and hence of intension) in ch. 2—particularly in §s ... and

A11 .9/1. That the analysis and design of 2Lisp made do with a single, coarser-grained notion of intension than the (hyper-intensional) 1Lisp stems in part from the fact that 2Lisp does not deal in any very serious way with issues of deixis and indexicality (cf. o3). To do that would have required a more “layered” conception of intensionality and context dependence, as discussed in §... of ch. 2.

Thesis τ_1 is ultimately less important than τ_5 , on p. 188.⁵ It is the intension-preservation, not the coarse-grainedness, that is important about statically-scoped LAMBDA_S.

A12 .9/-1/2:3 I no longer believe that functions *are* sets of ordered pairs; merely

4. Someone mathematically inclined might suggest modeling intensions *as* functions of some sort; the point would be that the range of LAMBDA is not those functions-used-to-model-intensions, but rather the functions whose intensions those functions are being used to model.

5. The labels ‘ τ_1 ’–‘ τ_5 ’ are not in the original dissertation; they were introduced for this version, to facilitate cross-reference.

that we standardly *model* them as sets of ordered pairs. Cf. [ch. 12](#).

- A13** [.10/-2/-2](#) Needless to say, the sentence “ α was Esther’s cousin” will be true just in case ‘ α ’ refers to the son of Jair, the hero of Purim, etc. (on the correct assumption that ‘Esther’ is being used, here, to refer to that person’s cousin, whom he brought up).

The first part of the sentence (“will be true if the supplied designator refers to Mordecai”) is not problematic, as the discursive context determines that this is the Mordecai being considered. It is the second half (“any term codesignative with the proper name “Mordecai”) that is problematic, since it is not obvious that the governing discursive context determines that “the proper name “Mordecai” denotes only that person’s name, as opposed to a name type shared by, among others, the Canadian author Mordecai Richler.

In general, the dissertation is culpably blind to issues of deixis, indexicality and other forms of use-level context-dependence. See [AQS](#).

- A14** [.11/0/-7](#) ‘Perhaps’ because there may be no country south of what is designated by the term that fills in the blank—if, for example, it were ‘Chile.’

- A15** [.12/0/7:9](#) The preternatural intimacy of connection between the compositional structure of language (noun phrases, verb phrases, etc.) and the standard ontological structures of the world (objects, properties, relations, etc.) has haunted me since the 1960s—decades before this dissertation was written. Cf. the discussion in [o3 \(p. 284\)](#) of whether God made the compositional structure of *world* on Tuesday, and of *word* on Friday—or whether, as I ultimately claim in that book, they are a two aspects of a single fact, best accounted for in an integrated notion of representation-*cum*-ontology.

- A16** [.12//5:-3](#) As I knew perfectly well at the time, the example shows that *temporal*, *locational*, *discursive*, and other forms of context matter as much as issues of *lexical position*. In 2014, if uttered in the U.S., “the President’s eldest daughter” would refer to Malia Obama; if used in France, to Clémence Hollande, etc.

- A17** [.179/0](#) As linguists and philosophers of language know only too well, issues of the appropriate understanding of intensionality in natural language are vastly more complex than this paragraph suggests. It was not until later in the 1980s that I learned enough linguistics to understand how amateur this paragraph really is.

Not only are the issues complex; there are deep underlying issues of what gets decided when, if ever. Imagine, for example, that in 2014 I ask someone whether, if they were President of the U.S., they would expect the First Lady to attend gala events. Even if the question seems fully understood, it can remain unclear whether the constituent singular term ‘the First Lady’ was intended, in my question, to refer to Michelle Obama, to my addressee’s current female partner, or to the person who would be their partner (perhaps female, but perhaps not necessarily) if that fictitious scenario were to come to pass. What is perhaps most striking about the example is how seemingly intelligible the question is *without this issue being resolved, even by the questioner*—suggesting that the “meaning” or “intension” of the question, if reifying it even makes sense, may not even require that such issues be settled. Or to take a different kind of example, consider the sentence “After the team’s ignominious defeat, every fan in the city took refuge in a local bar,”⁶ where the interpretation of the term ‘local’ is not determined by the locale relevant to the uttering of the sentence, but is (at least presumably) quantified so as to be depend on each separate fan. Does that mean that in this sentence ‘local’ occurs in an intensional context? And so on.

As suggested in ch. 2, particularly in the discussion of contextual layering in §..., intensional issues in computation are equally complex. As perhaps the simplest non-trivial example, consider so-called “left-hand values”—as for example in code fragment “ $x[3]:=7$ ”, intended to set the third element of array x to 7. Neither the term ‘ $x[3]$ ’ in the computational expression—nor, for that matter, the term “the third element of array x ” in the English gloss—is straightforwardly in an “extensional position,” in the sense of referring to what the same computational term would refer to if used in a “right-hand side” context, such as “ $27+x[3]$,” or the same English phrase would refer to in a statement “the third element of the array is 49.”

While by no means its only motivation, one of the aims of the proposed fan calculus is to provide a flexible way of dealing with these layered or even intertwined notions of contextual “narrowing,” so that distinctions between and among them can be made visible—“foregrounded,” as it were—when that is appropriate, and

6. A sentence in famous among linguists; «ref».

allowed to subside into the background, when they are not at point.

A18 .13/1/1ff This sentence has been slightly expanded from the original (in the dissertation) to enumerate these four points explicitly, so to make its original meaning clear. The original sentence read as follows:

“Simply this: that the natural way to view lambda terms is as expressions that designate functions, where the function designated is determined with respect to the context of use where the lambda term is used (‘used’ in the sense of ‘stated’ or ‘introduced’—not where the function it designates is applied).”

A19 .13/-3/2:4 Cf. §5c of the Introduction.

A20 .14/0/0:2 For example, under a substitutional regimen the expression:

((LAMBDA EXPR [F] (+ F F F)) (PROGN (PRINT "hello") 3))

would print “hello” three times before returning 9.

A21 .15/0/-3:-1 Cf. note 9 in annotation A14 of ch. 3b, on p. .142, re this incorrect usage of the term ‘syncategorematic.’

A22 .15/-1 This paragraph has been more than usually edited, for this version, in order to make its points clearer. The rewritten version extends from .181/1 through .183/0.⁷

A23 .18/0/-9:-7 Why was this was not written referentially, as: “(CARDINALITY PLANETS) might reduce to the numeral 9 if CARDINALITY *denoted cardinality*”? Presumably because: (i) the prior sentence states that atom PLANETS not only “designates the sun’s planets,” but is also “bound to the rail [MERCURY VENUS EARTH ... PLUTO]”; and (ii) procedurally, as regards what the redex *reduces to*, it is the binding, not the reference, that

7. The original version reads as follows:

“The answer is that the λ -calculus is highly constrained in certain ways which enable hyper-intensional substitution protocols to mimic a more abstract intensional kind of behaviour. Two features contribute to this ability. First, there is no QUOTE primitive (and of course no corresponding disquotatation mechanism), so that it is not possible in general and unpredictable ways to capture an expression from one context and to slip it into the course of the reduction in some other place “behind the back of the reduction rules,” so to speak. Second, there is that very important rule having to do with variable capture, called α -reduction. It is a constraint on β -reduction—the main reductive rule in the calculus—that terms may not be substituted into positions in such a way that a variable would be “captured” by an encompassing λ -abstraction. If such a capture would arise, one must first rename the

determines the outcome. Still, it would be have been more in line with the project's overall deferential semantical stance to include the declarative aspect of the story, even if that had required adversion to the presumption of a closed-world assumption.

A24 18/0/-4:-3 Notwithstanding this claim, I, like many others, would have been astonished, in 1981, if someone had foretold that in 2012 the number of planets would have been reduced to 8.

A25 :20/2/1 The label 's4-132' refers to a definition on p. 288 of the full dissertation; for a link to an internet accessible version of the dissertation cf. P.....

A26 :21/1/2 To say that “the full computational significance of both hyper-intensional and intensional computational expressions does not *re-lease* the full computational significance latent in their ingredients” (emphasis added) seems misformed.

What must have been intended is that the procedural consequence of intensional and hyper-intensional terms does not directly include the procedural consequence of their ingredients, in the sense that processing an intensional or hyper-intensional structure x will not necessarily generate the behaviour that would (and perhaps will) be engendered by subsequent uses of the structure y to which

...
parameters involved in such a fashion that the capture is avoided. For example, the following is an incorrect series of β -reductions:

[23], as in the text (:182/1)

Rather, one must use an instance of α -reduction to rename the inner F so that the substitution of the binding of G for G will not inadvertently lead that substitution to ‘become’ an instance of the inner binding. Thus the following is correct:

[24], as in the text (:182/3)

The precise and only role of α -reduction in the λ -calculus is to rearrange textual objects so as to avoid the dynamic scoping that would be implied if α -reduction did not exist.”

8. Note that this does not mean that the results of normalising LAMBDA redexes and other intensional terms fail to be side-effect-free (in the sense defined at :82/3, in ch. 3b)—which would violate the claim, and general condition on normalisation, that they are in *normal-form*. Rather, it means that although those co-intensional and co-extensional normal-form function designators themselves are side-effect free, their use in function position in the reduction of other redexes may “unleash” additional behaviour.