Some Thoughts on Languages for Statistical Computing and Graphics

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Graphics to Language

- New ideas in 1980s for exploring data with dynamic graphics:
  - Point cloud rotation;
  - Linked brushing in scatterplot matrices.
- Intriguing, but used specialized/expensive hardware.
- Apple Macintosh provided new opportunities.
  - First approach: create some stand-alone applications
- Challenges
  - Need to get data into the applications.
  - How to experiment without having to rebuild the application.
- Natural approach:
  - Embed graphics in a language.
  - Allow customization using the language.

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- Build on an existing general-purpose language or design a new one?
- Some possible general purpose language choices at the time:
  - APL
  - Lisp
- Lisp seemed a good choice
  - Available C implementations for modification.
  - Used by a number of other researchers.
- XLISP was used as the basis for Lisp-Stat.
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Useful Language Features

- Valuable features:
  - Vector-oriented operations.
  - First class functions.
  - Good error and warning handling.
  - A module system.
  - Framework for interfacing to lower-level languages.
  - Compiler to reduce the need for lower level languages.
- Supporting interactive graphics:
  - Object oriented programming framework.
  - Custom event handlers.
- Features not supported by Lisp-Stat
  - Missing value propagation.
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Lisp(-Stat) Features in R

- R now incorporates Many features originally explored in Lisp-Stat.
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- One feature that is not supported:
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Language Challenges

- For simple tasks, graphical interfaces are often easier to learn.
- With a language-based system:
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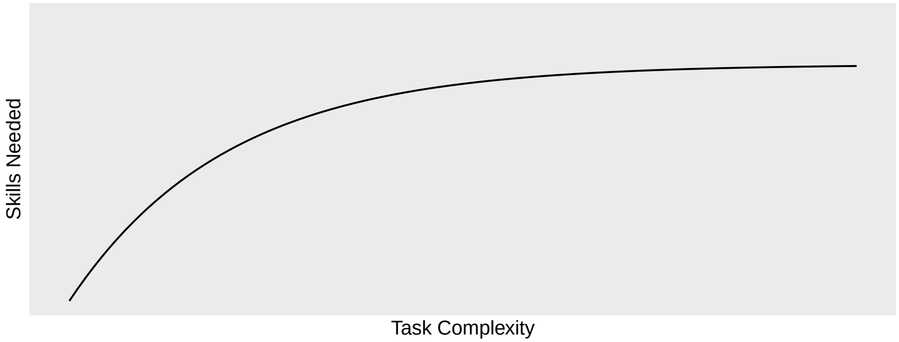

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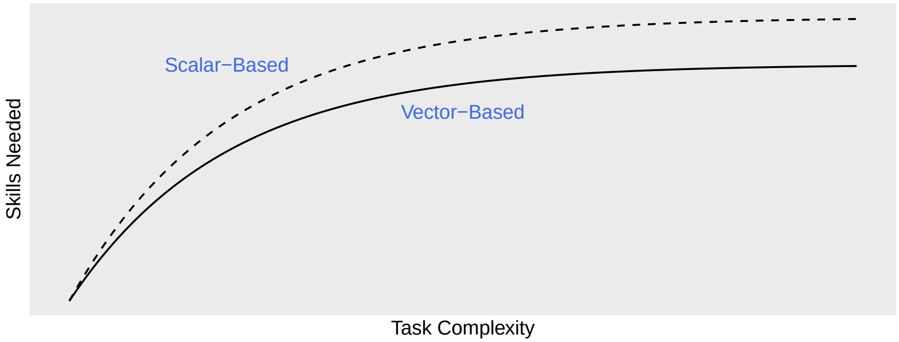

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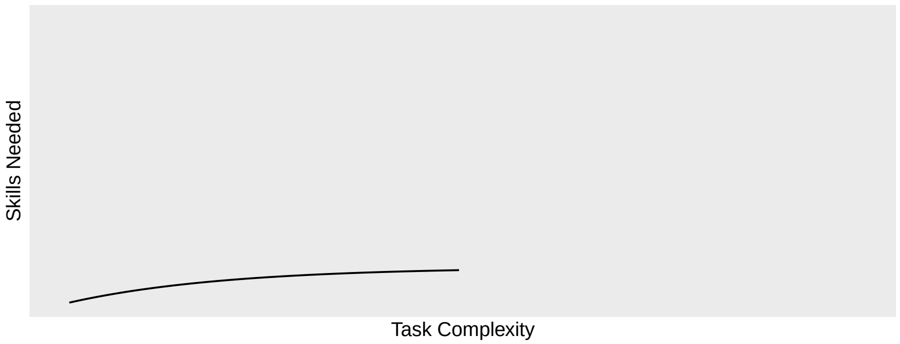
- But at some point a transition to VB is needed to go further.
- Graphical interfaces built on a language system like R can try to mitigate this transition.



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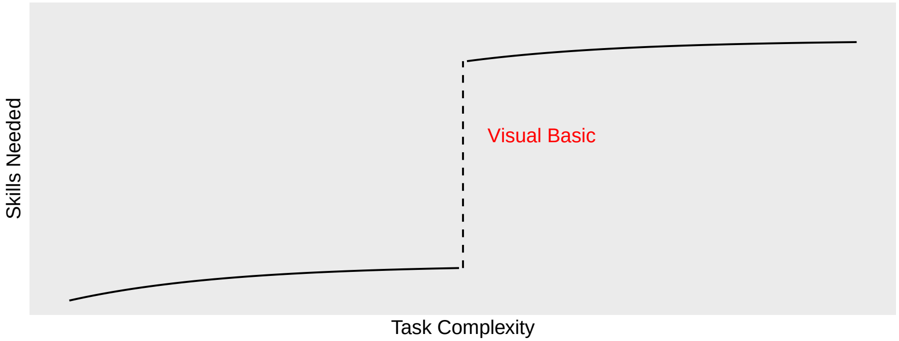

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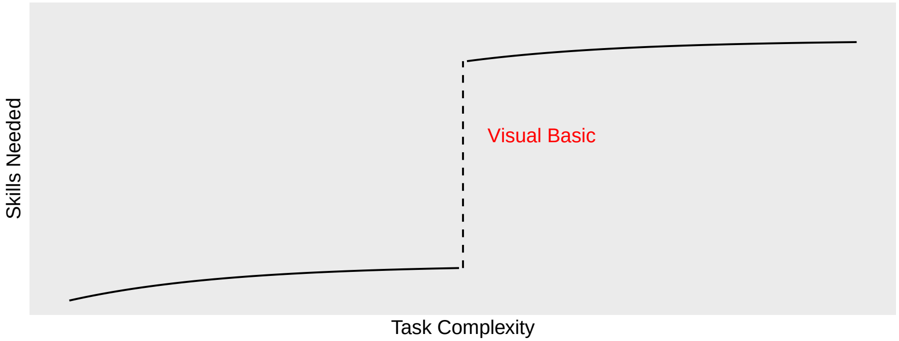

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- R shares with Lisp the ability to build new sub-languages on top of the basic language.
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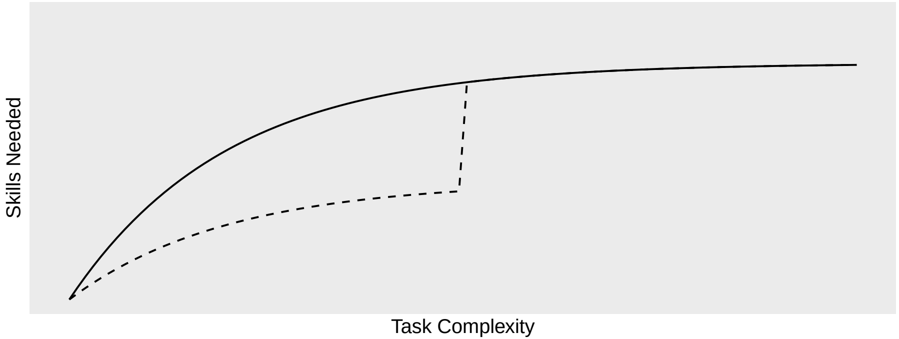

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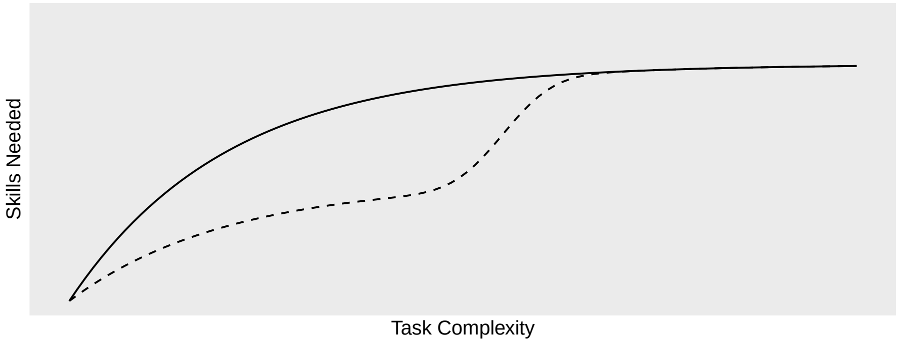

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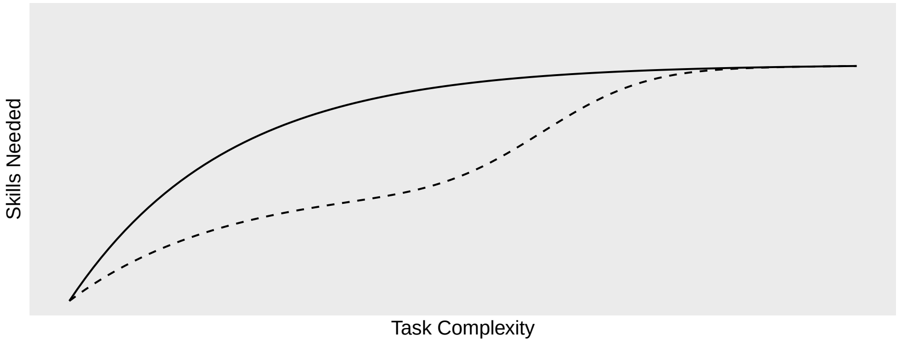

Some Directions for R

- With the growth and success of R come challenges:
  - Changing language features in hard, but sometimes possible.
  - Changing implementation features is hard, but sometimes possible.
- A language change that may happen:

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- Some implementation changes being explored:
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