Liberating Pair Programming Research from the Oppressive Driver/Observer Regime

Lutz Prechelt
Freie Universität Berlin, Institut für Informatik
Definition: Pair Programming (PP)

From [WilKesCun00]
"In pair-programming,

- two programmers jointly produce one artifact (design, algorithm, code, etc.).
- The two programmers are like a coherent, intelligent organism **working with one mind**, responsible for every aspect of this artifact.
- One partner is the 'driver' and has control of the pencil/mouse/keyboard and is writing the design or code.
- **The other person continuously and actively observes** the work of the driver -- watching for defects, thinking of alternatives, looking up resources, and considering strategic implications of the work at hand.
- **The roles of driver and observer** are deliberately switched between the pair periodically.
- Both are equal, active participants in the process at all times and wholly share the ownership of the work products whether they be a morning's effort or an entire project."
Roles model of this definition

- Driver + Observer constitute the PP process

- Driver is recognized simply from "having the keyboard"
Doubts

• There is a contradiction between "working as one mind" and the different responsibilities ascribed to the roles

• Prior research found that the partners are not typically working at different levels of abstraction

• However, an alternative roles model has not yet been proposed
Why is this of interest?

• PP advocates claim many advantages from using PP:
  • High productivity
  • Better resulting design
  • Fewer defects
  • Strong mutual learning
  • etc.
• But empirical results are either lacking or show wide variation
• We do not know how to do PP 'right'
  • We do not even know what it means to do PP at all
• Understanding PP roles may help with both
AG SE research approach

Goal:

- Characterize the PP process conceptually
  - important mechanisms, typical event episodes, styles, ...
  - Describe helpful behaviors as process patterns
  - Describe hampering behaviors as process anti-patterns

- Approach:
  - Bottom-up empirical analysis:
    - Use audio/video recordings of PP sessions
    - Conceptualize locally
    - Find structure
  - Not a short single study, but a long-term research program
  - Main research method: Grounded Theory Methodology

Lutz Prechelt, prechelt@inf.fu-berlin.de
Initial insights

- Such data is **shockingly** rich
- Should focus on verbal interaction
- Many many utterances appear ambiguous
- Many many actions are ambiguous/multilayered
- 1st goal: Must get clarity for basic dialog steps

Lutz Prechelt, prechelt@inf.fu-berlin.de
## Base Concept Set: HHI concepts

### product-oriented concepts
- ask_design
- challenge_design
- decide_design
- disagree_design
- remember_requirement
- challenge_requirement
- propose_requirement
- mumble_sth
- off_topic

### process-oriented concepts
- ask_step
- agree_step
- decide_step
- propose_step
- disagree_step
- amend_step
- challenge_step
- agree_strategy
- challenge_strategy
- propose_strategy
- amend_strategy
- say_strategy

### explain_completion
- explain
- gap_in_knowledge
- standard_of_knowledge
- explain
- activity
- hypothesis
- knowledge
- activity
- hypothesis
- knowledge
- activity
- hypothesis
- knowledge
- activity
- hypothesis
- knowledge
- activity
- source_of_information
- finding
- challenge
- finding
- agree
- finding
Again: Roles model of the traditional PP definition

- Driver + Observer constitute the PP process
- Driver is recognized simply from "having the keyboard"
New, open-ended roles meta-model

**Diagram:***

- **Action**
  - is part of **Episode**
  - promotes or inhibits **Personality Traits**
  - leads to **Role**

- **Episode**
  - is part of **Context**
  - may direct **Role**

- **Role**
  - consists of **Facet A**, **Facet B**, **Facet C**, and **Facet D**
  - influences **Findings/Knowledge**

- **Personality Traits**
  - promotes or inhibits role

- **Findings/Knowledge**
  - influenced by role
Finding 1:
A Role consists of Facets

(We have not identified many roles yet, so we focus on the meta-model and only use roles as examples)

- A **Role** is described via several characteristic **Facets**
- e.g. the role **watchman** has three Facets:
  - **recognizing hazards**: looking for dangers, e.g. when the current set of files is not up-to-date or when not finishing the task could hamper the release process
  - **setting priorities**: Insisting that something be done now or early enough to avoid negative or ensure positive consequences.
  - **shifting**: Triggering a switch from one context of consideration (e.g. the PP session) into another (e.g. the overall software process)
Recognizing role-fillings from Facets and Actions

- The Facets as such are missions/intentions/responsibilities and are thus not directly observable, but **Actions** resulting from them are:
  - e.g. looking for hazards is unobservable but warning of a hazard is observable
- Sometimes a single Action and Facet is enough to diagnose a role-filling
- Sometimes repeated Actions or multiple Facets are required
Finding 2: Roles require skill

- All three Facets of the watchman Role involve learnable skills
  - searching for hazards
  - setting priorities
  - shifting

Therefore,
- recognizing and understanding the role (in research) may lead to process patterns;
- understanding the role (as a practitioner) may improve the PP behavior
Finding 3: Role-fillings depend on Context

- Role **task expert** has two facets:
  - pass on task knowledge explicitly
  - turn task knowledge into proposals
- Which of these will appear depends on the current **Context**, e.g.
  - within a knowledge transfer **Episode**, only Facet 1 will appear
  - in a session, where knowledge transfer is not a goal, Facet 1 will hardly ever appear
- (Seeing one Facet is almost always enough to diagnose a task expert)
Finding 4: Role likelihood may depend on personality traits

• The **spokesperson** Role means being a representative for a certain concern. It has three Facets:
  • **opening a dialog** about the concern.
  • **carrying forward the dialog**, often in such a way that expert knowledge is not required.
  • **rounding off the dialog**: Not accepting an end of the dialog without a resolution of the concern.

• The Role is typically assumed by the more assertive member of a pair
  • being assertive is a personality trait, not a Facet

Lutz Prechelt, prechelt@inf.fu-berlin.de
Finding 5: Some roles have counterparts

- If member A is task expert in Facet-1 (knowledge-passing) mode, member B is usually mentee
- mentee need not occur in pure Facet-2 (proposing) mode

- Some combinations of roles are even mandatory:
  - Member A can be guide only if Member B acts as robot
Finding 6: Role-filling can be gradual, intermittent, and concurrent

- A Role assumption may start and end gradually over a stretch of time.

- Having a Role does not mean acting out that Role at every moment.

- A pair member may have more than one Role at the same time.

- The full version of the meta model has additional classes such as Role-Filling and Facet-Execution
Finding 7: There may be no canonical Roles catalog

• Before we found *task expert*, we had a Role * updater
  • much more specialized.
  • We are happy with task expert: updater is gone for good and task expert will likely stay

• However, before we found *watchman*, we had a Role *foreign minister*
  • who had a subset of the *recognizing hazards* Facet only.
  • But even the more general watchman does not feel final.

• The final solution may be a set of *overlapping* roles
  • from which a pair can select those that fit best to their task, circumstances, and work style.
Summary

- The driver/observer roles model is simplistic and unrealistic
  - It is also not constructive (does not provide advice)

- There are far more than two roles in the PP process

- Roles are such complex constructs that their definition is arbitrary to some degree
  - Hence, there may be no fixed true-for-all catalog of roles

- Roles talk about the responsibilities being assumed
Thank you!