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# **An Empirical Study of God Methods Detection**

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# Our Study

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## Exploratory Study

- investigates and compare the effectiveness of two heuristics to detect one bad smell.
  - we used two heuristic rules composed with a set of traditional and concern metrics to detect God Method smell.
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# Goal Study

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- **Compare two heuristic rules**
    - participants x researcher
  
  - **Detection one code smell**
    - God Method
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# What is God Method?

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- Method that has grown too much
  - It tends to centralize the functionality of a class
  - In a different perspective:
    - it is a method that implements many concerns
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# Target System

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- **MobileMedia**
    - Concerns analyzed:
      - Sorting
      - Favorites
      - Persistence
      - Exception Handling
      - Security
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# Metrics

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- **Metrics used in the experiment**
    - **Traditional metrics**
      - Lines of code (**LOC**)
      - McCabe Cyclomatic Complexity (**CYCLO**)
    - **Concern metrics**
      - Number of Concern Lines of Code (**LOCC**)
      - Number of Concerns per Method (**NCO**)
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# Study Settings

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- **Participants**
    - 18 participants worked in pairs (UFMG)
  - Each pair worked with both heuristic rules in different orders
    - H1 and H2 (Model 1)
    - H2 and H1 (Model 2)
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# Study Settings

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- **Experimental Tasks**

- Training on the metrics and God Method
  - The participants only had access to the metrics used by the heuristic rules
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# Study Settings

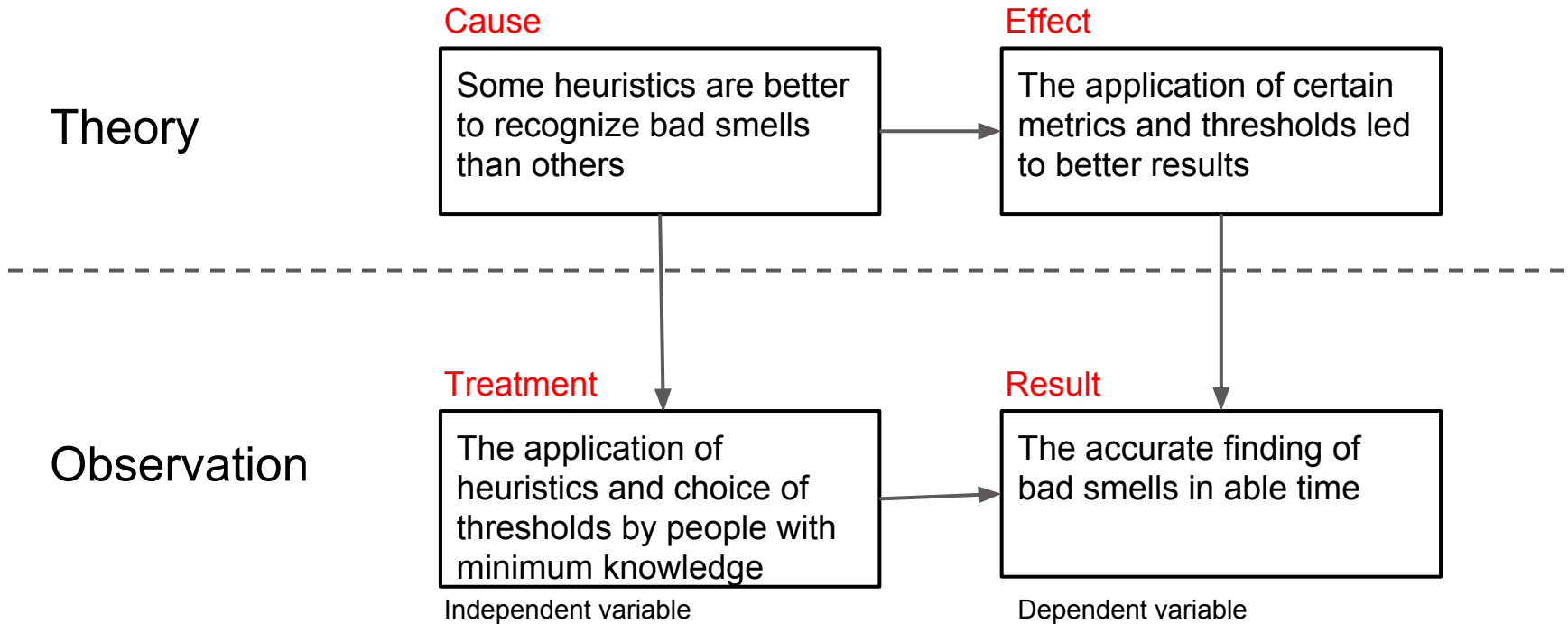
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- **Each pair**
    - Read the description of the MobileMedia design
    - Defined thresholds for each metric used in the heuristic rules
    - Identified the methods with God Method using both heuristic rules
    - Registered the time spent on each task
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# The experiment

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## Experiment Goals



## Experiment Execution

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# God Method Reference List

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## Methods smelling God Method

MainUIMidlet.startApp	MediaListController.showMediaList
AlbumController.handleCommand	MusicPlayController.handleCommand
MediaController.handleCommand	PhotoViewController.handleCommand
MediaController.showImage	

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# Recall and Precision

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Hits

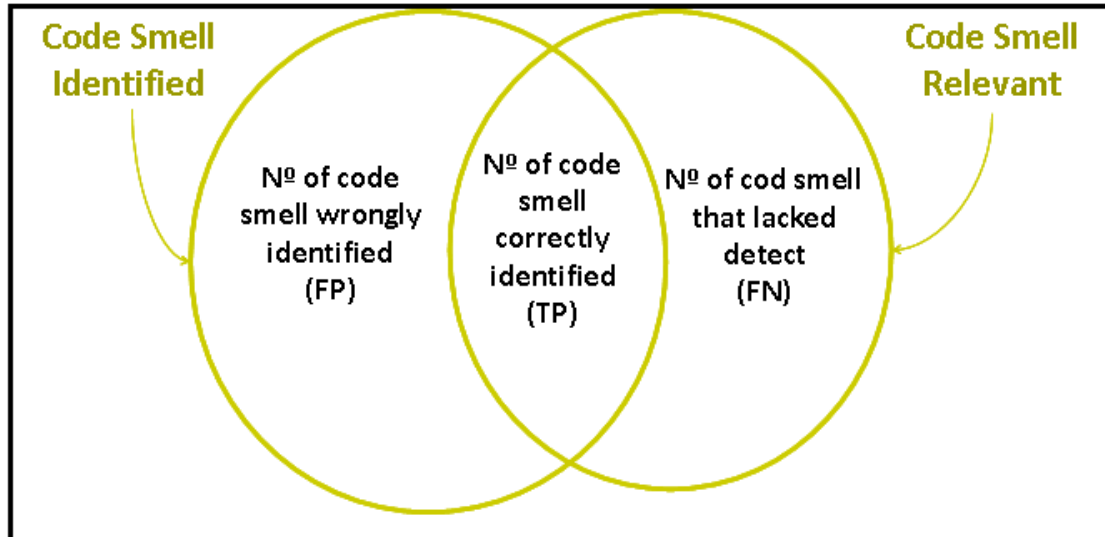
- True Positive (TP)

Error

- False Positive (FP)
  - False Negative (FN)
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# Recall and Precision

## Identification of Code Smell



$$\text{Recall: } \frac{TP}{TP+FN}$$

$$\text{Precision: } \frac{TP}{TP+FP}$$

# Research Questions

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- **RQ. Does the heuristics rules defined support God Method detection?**

**RQ1.** What heuristic rule (H1 or H2) is more efficient?

**RQ2.** In which heuristic rule (H1 or H2) participants consumed more time?

**RQ3.** Participants who have work experience can influence the rate of hits?

# Accuracy of the Heuristic rules

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- **Main goal of this study is**
    - The evaluation of the effectiveness of two concern-based heuristic rules to detect God Method
    - We considered two heuristic rules
      - **H1 :  $LOC_m$  and CYCLO and NCO**
      - **H2 :  $LOCC_m$  and CYCLO and NCO**
  - Both seem helpful to detect God Methods
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# Analysis of Heuristic Rule 1

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**RQ1.** What heuristic rule (H1 or H2) is more efficient?

	Heuristic Rule 1 (H1)									
Participants	S1	S2	S3	S4	S5	S6	S7	S8	S9	Average
Recall (%)	43%	43%	71%	71%	43%	57%	29%	43%	57%	<b>46%</b>
Precision (%)	100%	100%	100%	100%	100%	80%	100%	100%	50%	<b>81%</b>
Time (m)	9	5	14	7	5	9	13	19	16	<b>9</b>

# Analysis of Heuristic Rule 2

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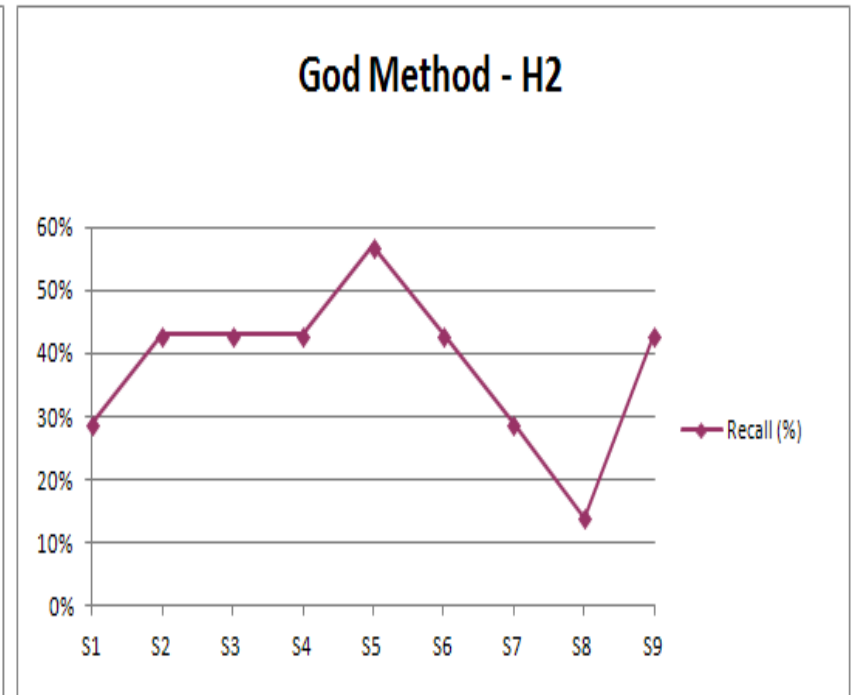
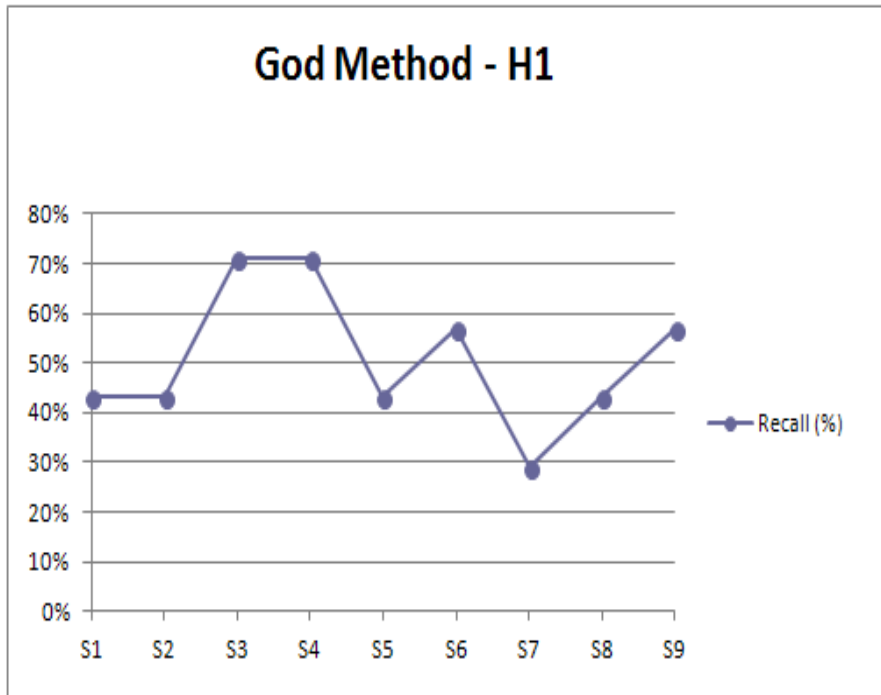
**RQ1.** What heuristic rule (H1 or H2) is more efficient?

**Heuristic Rule 2 (H2)**

<b>Participants</b>	S1	S2	S3	S4	S5	S6	S7	S8	S9	<b>Average</b>
<b>Recall (%)</b>	29%	43%	43%	43%	57%	43%	29%	14%	43%	<b>37%</b>
<b>Precision (%)</b>	100%	50%	100%	50%	0%	60%	100%	100%	43%	<b>56%</b>
<b>Time (m)</b>	5	17	9	12	17	7	9	16	21	<b>11</b>

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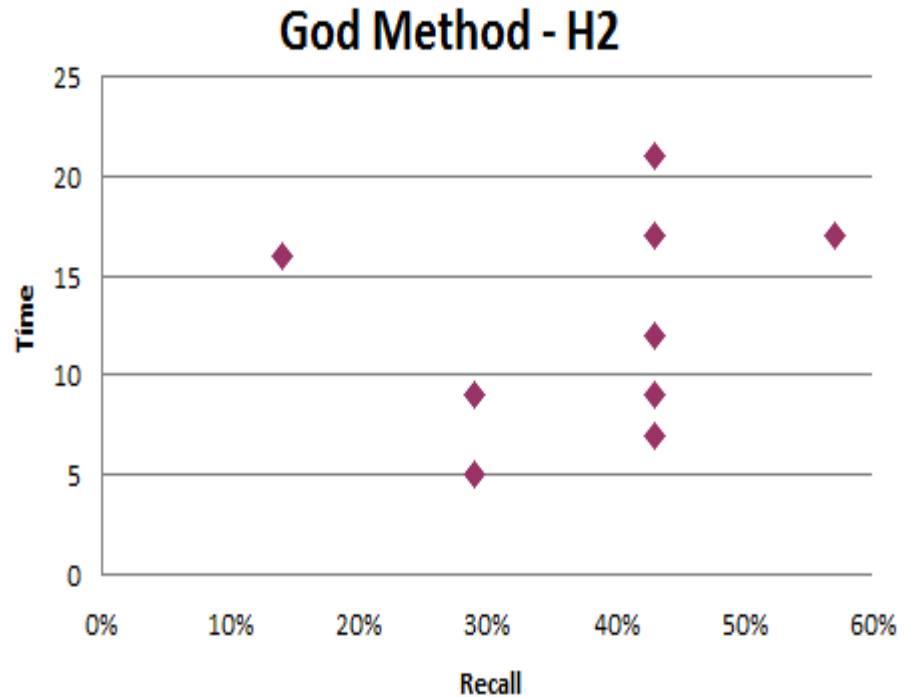
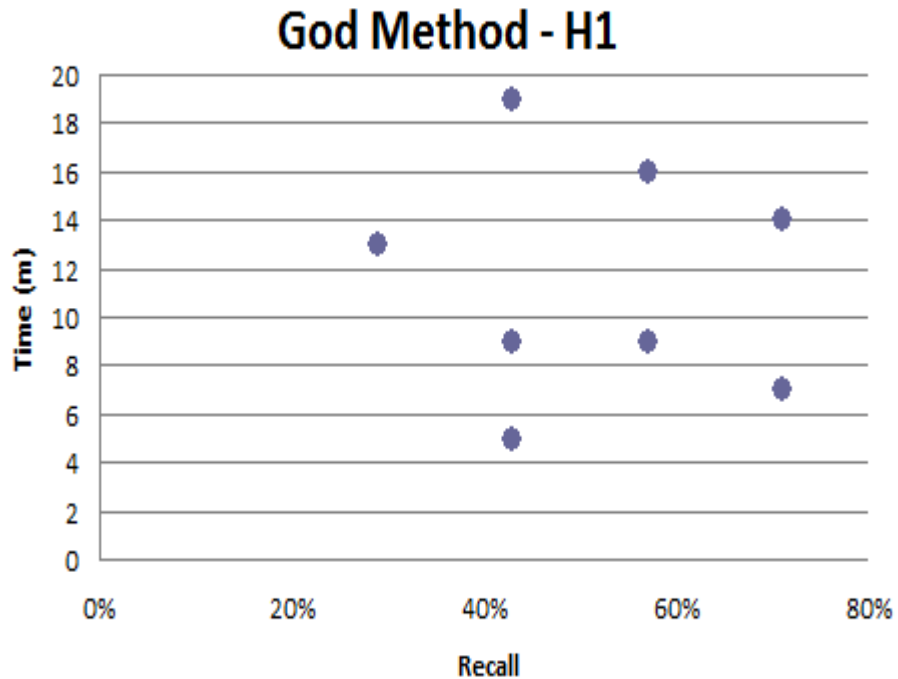
# Analysis of Heuristic



**H1 - allowed participants to achieve higher Recalls**

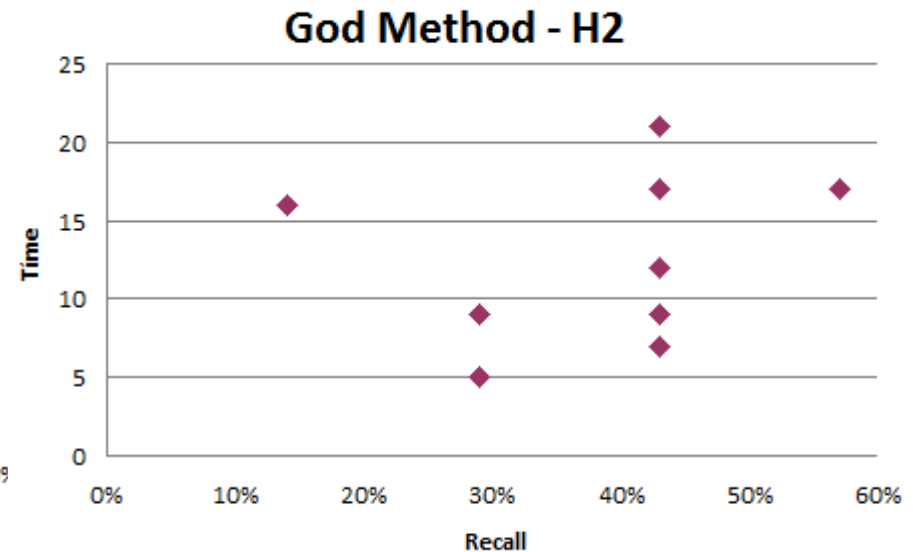
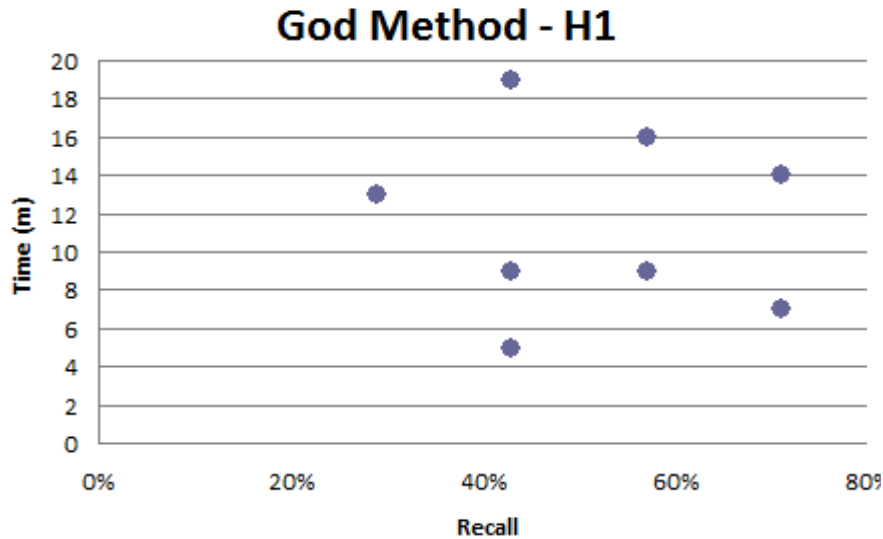
# Analysis of Time Efficiency

**RQ2.** In which heuristic rule (H1 or H2) participants consumed more time?



# Analysis of Time Efficiency

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On average, participants spent more time on H2 than in H1

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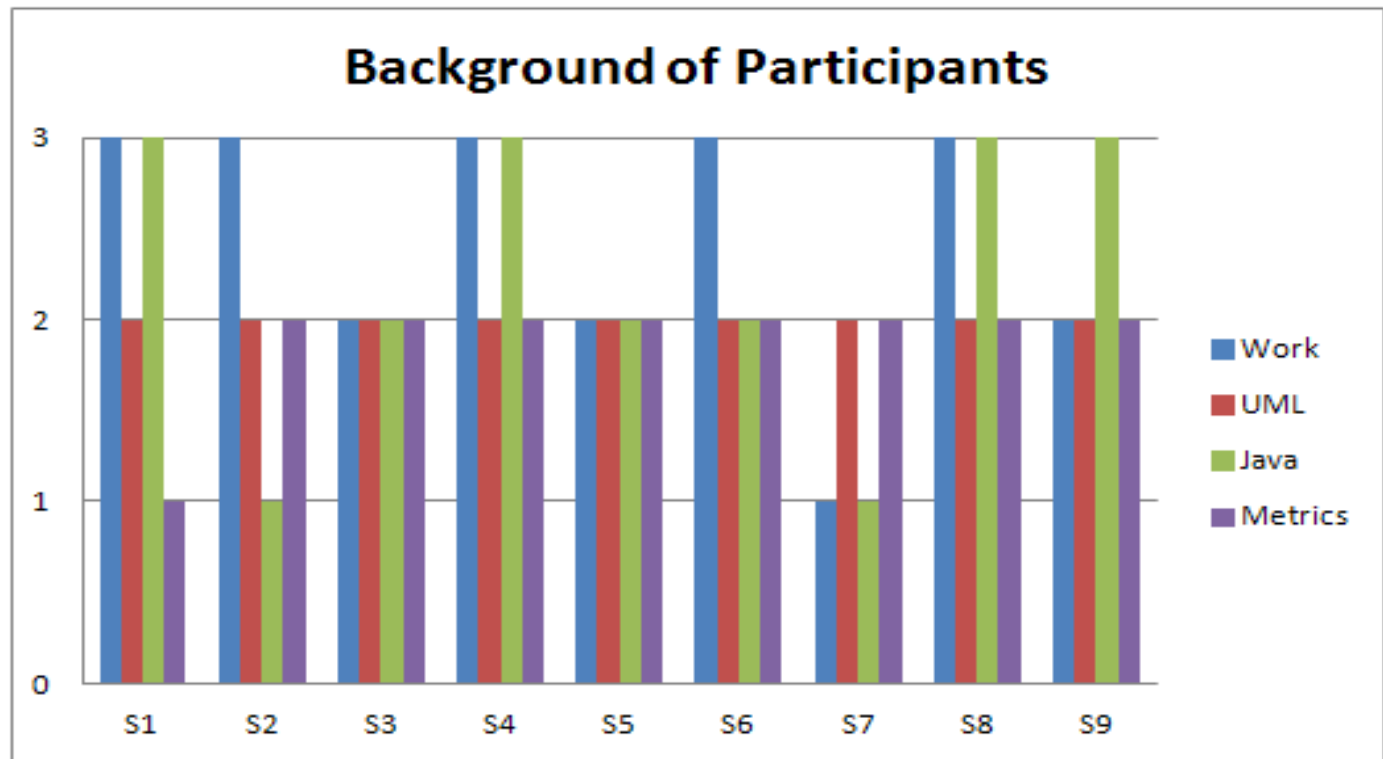
# Analysis of Background Participants

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**RQ3.** Participants who have work experience can influence the rate of hits?

SCALE:

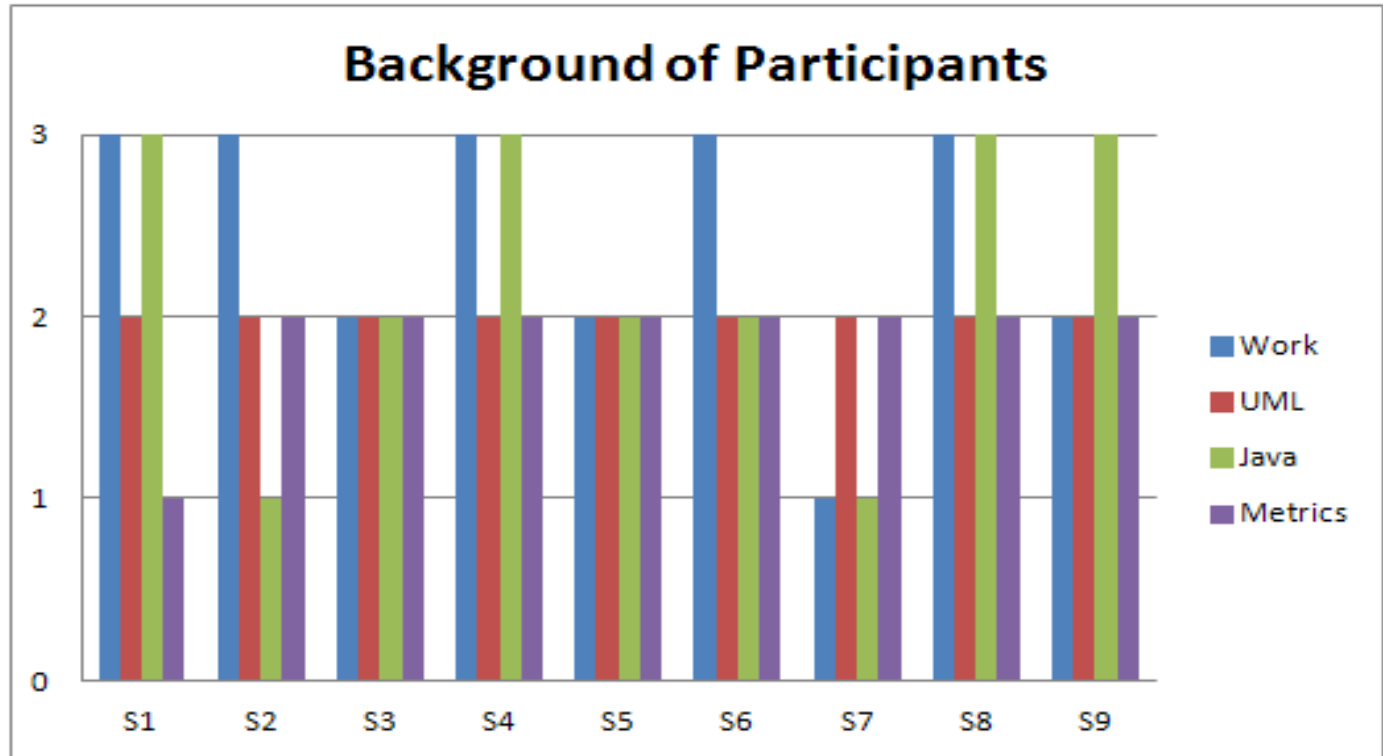
0 = None  
1 = Few  
2 = Medium  
3 = High



# Analysis of Background Participants

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SCALE:  
0 = None  
1 = Few  
2 = Medium  
3 = High

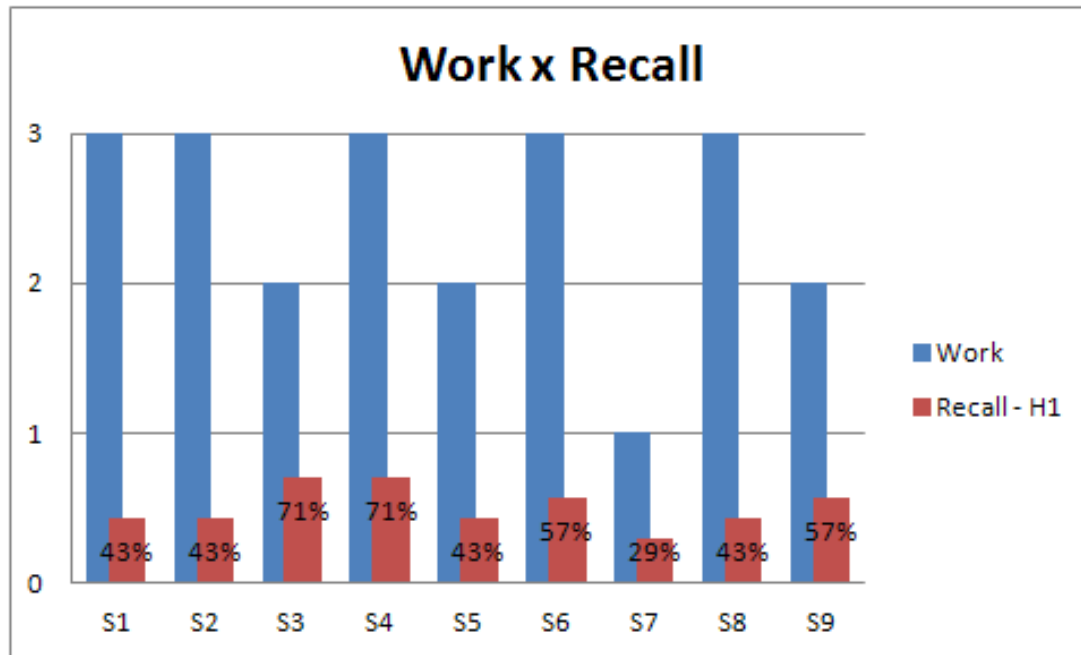


Work experience varies more than knowledge in Java

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# Analysis of Background Participants

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Work Experience does not influence the accuracy rate of participants

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# Validity threats

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- **Internal**

The experiment is not internally valid, the participants were exposed to classes about how to conduct experiments of the same kind, it may have affected them

- **External**

The results could be generalized and applied to a larger population

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# Validity threats

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- **Construct**

The outcome corresponded to the effect we were expecting

- **Conclusion**

Our hypothesis was proved to be accurate, but the low statistic database might conduct us to wrong conclusions

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# Validity threats

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- **Credibility**

The results are in accord with main related works, what led us to believe that they are true

- **Dependability**

The results may not be repeated exactly as they were recorded, once the participants were submitted to specific classes about how to plan and conduct software engineering experiments

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# Conclusions

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- **Results indicated**

- H1 allowed participants to achieve higher Recalls
  - The average Precision and Recall were also higher for heuristic H1
  - On average, participants spent more time on H2 than in H1
  - Work experience does not influence the accuracy rate of participants
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# Questions

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