

THE PREVALENCE AND IMPACT OF PERSISTENT AMBIGUITY IN SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENTS

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OVERVIEW

- Problem Statement
- Inspection Process
- Modifier Ambiguity Results
- Referential Ambiguity Results
- Elliptical Ambiguity Results
- Conditional Clause Ambiguity Results
- Plural Ambiguity Results
- Interview Results

PROBLEM STATEMENT

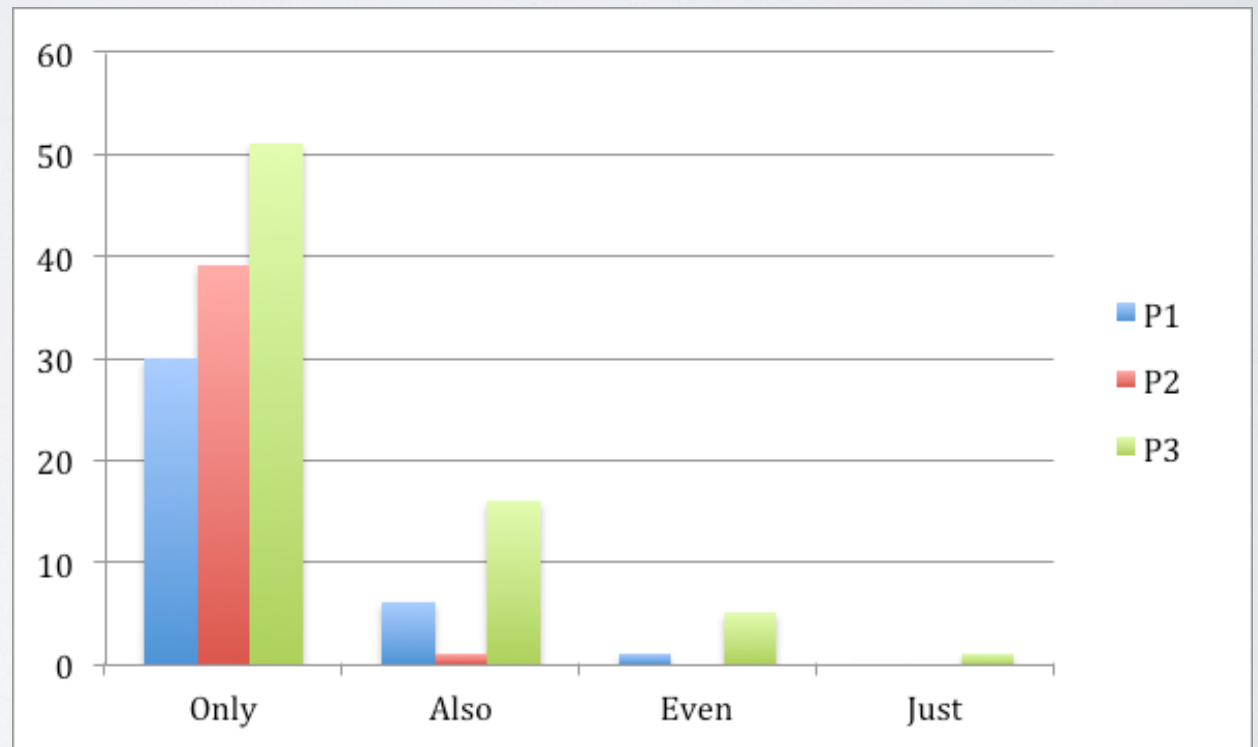
- Recent studies have indicated that requirements ambiguity seems to be resolved through multiple inspections and discussions
- Inspections may not catch ambiguity types that are likely to results in subconscious disambiguation
- People are likely unaware of and incapable of recognizing these ambiguity types; therefore these types are likely to remain after multiple inspections
- This kind of ambiguity is defined as persistent ambiguity and may cause expensive damage
- The prevalence and potential impact of persistent ambiguity was investigated

INSPECTION PROCESS

- Three Projects (P1, P2, & P3) were inspected for the following ambiguity types: modifier, referential, elliptical, conditional clause, & plural
- An ambiguity exists if there is more than one possible interpretation after taking context into consideration
- The chief requirements Engineer (RE) of each project was interviewed to determine if any damage was caused by the ambiguities identified

INSTANCES OF MODIFIER CUE WORDS

- The total number of instances of:
 - **only** is 120
 - **also** is 23
 - **even** is 6
 - **just** is 1
- Totalling 150 instances



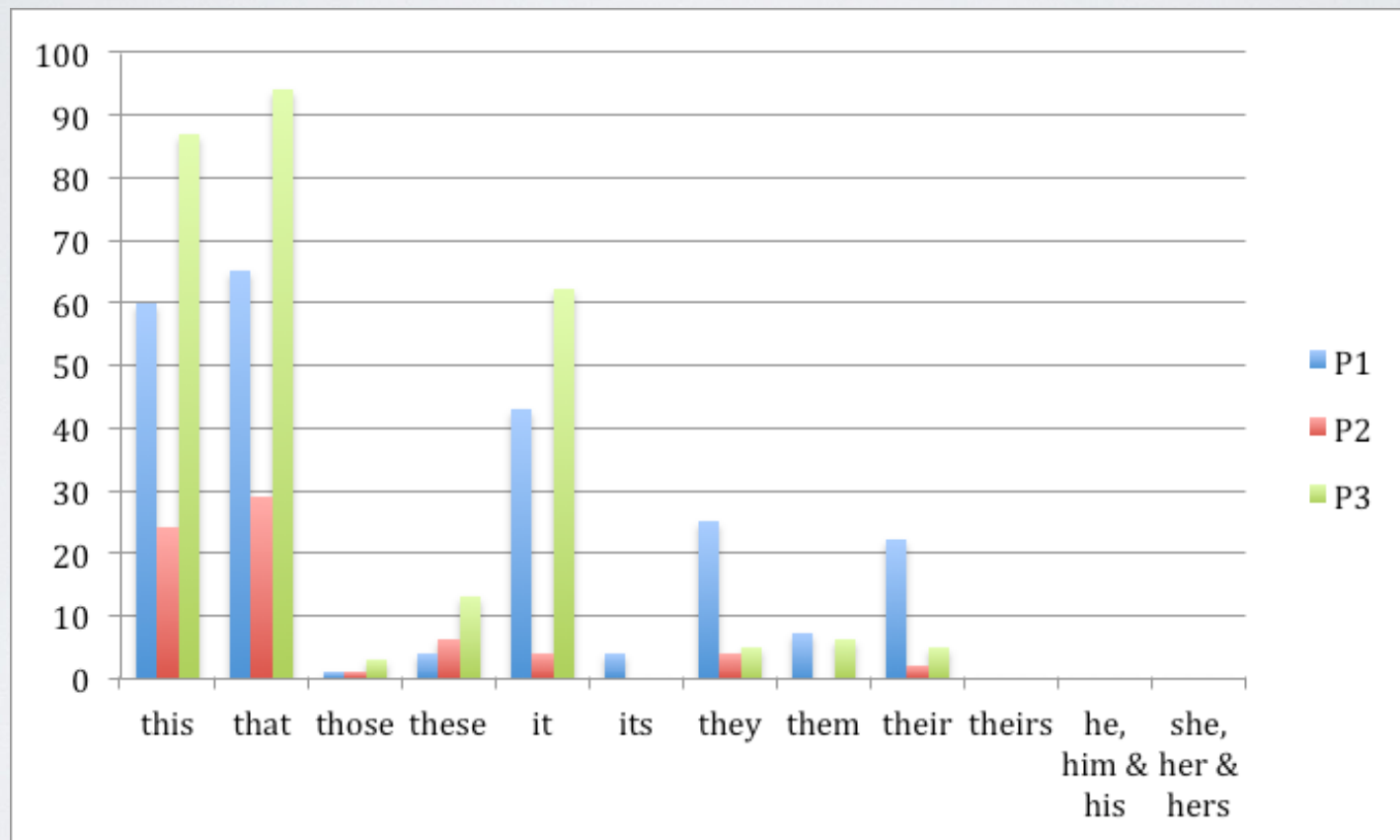
INSTANCES OF AMBIGUITY

- One instance of ambiguity identified
- Despite the prevalence of modifiers, modifier ambiguity did not prove to be an issue for each of the projects
- The REs placed modifiers before the main verb less often than elsewhere, 42 times out of 150
- When they used this placement context disambiguated successfully 65 times out of 66

INSTANCES OF REFERENTIAL CUE WORDS

- The total number of instances of:
 - **this** is 171
 - **that** is 188
 - **those** is 23
 - **these** is 5
 - **it** is 109
 - **its** is 4
 - **they** is 34
 - **them** is 13
 - **their** is 29
 - **theirs** is 0
 - **he, him & his** is 0
 - **she, her & hers** is 0
- Totalling 576 instances

INSTANCES OF REFERENTIAL CUE WORDS

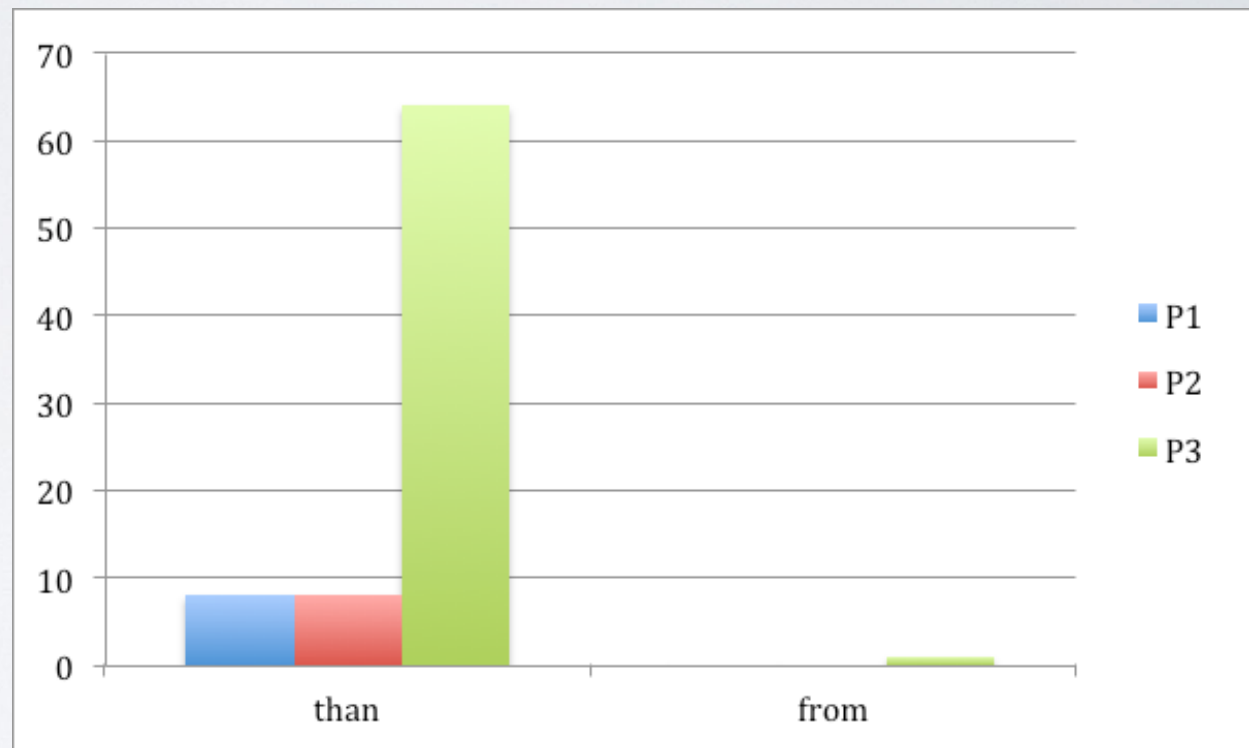


INSTANCES OF AMBIGUITY

- Eleven instances of ambiguity identified
- Referential ambiguity did prove to be an issue for PI
- The REs commonly used determiners & pronouns, and context does not disambiguate successfully some of the time
- Even though the REs used demonstrative determiners far more often than demonstrative pronouns, demonstrative pronouns may still lead to ambiguity

INSTANCES OF ELLIPTICAL CUE WORDS

- The total number of instances of:
 - **than** is 80
 - **from** is 1
- Totalling 81 instances



INSTANCES OF AMBIGUITY

- Zero instances of ambiguity identified
- Zero instances of elliptical cue words that indicate an actual ellipsis
- Elliptical ambiguity did not prove to be an issue in the three projects inspected
- REs in each of these projects seem to be aware of the dangers of elliptical ambiguity

INSTANCES OF CONDITIONAL CLAUSE CUE WORDS

- The total number of instances of:
 - **assuming so** is 0
 - **assuming not** is 0
 - **suppose so** is 0
 - **suppose not** is 0
 - **if so** is 2
 - **if not** is 2
- Totalling 4 instances

INSTANCES OF AMBIGUITY

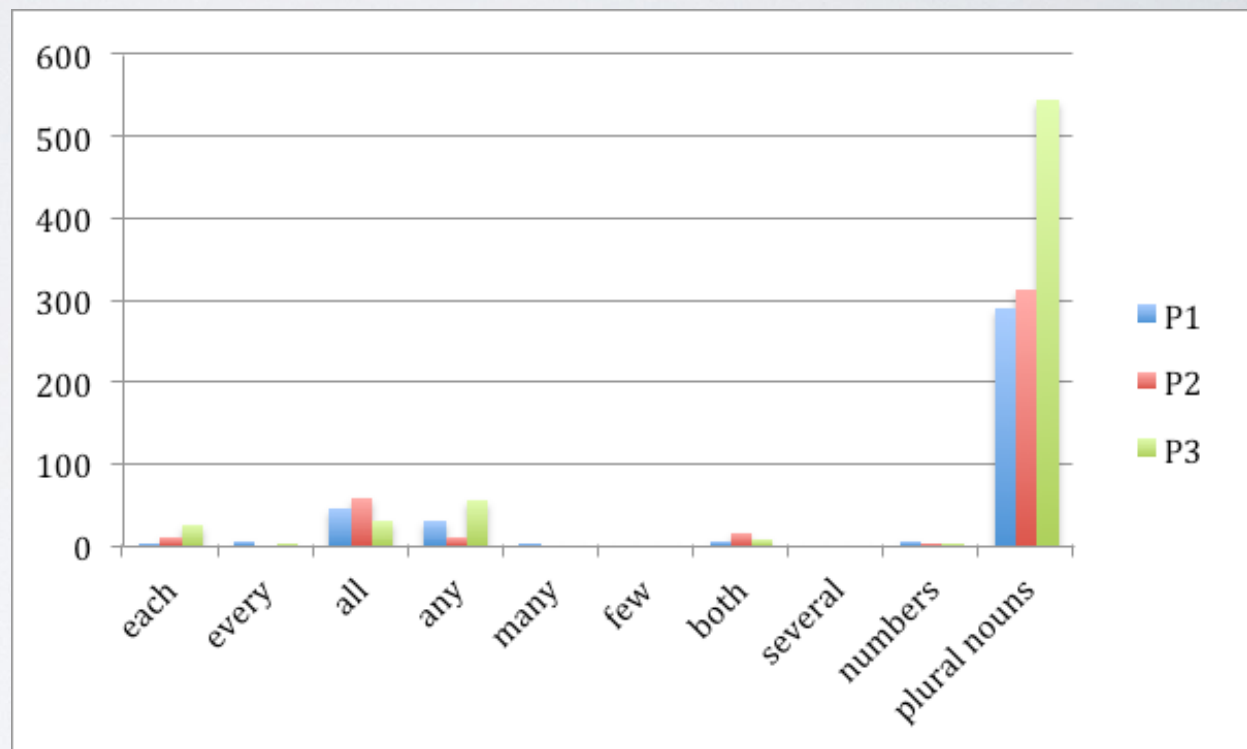
- Zero instances of ambiguity identified
- Conditional clause ambiguity did not prove to be an issue in the three projects inspected
- REs in each of these projects seem to be aware of the dangers of conditional clause ambiguity

INSTANCES OF PLURAL CUE WORDS

- The total number of instances of:

- **each** is 39
- **every** is 5
- **all** is 133
- **any** is 96
- **many** is 3
- **few** is 0
- **both** is 30
- **several** is 0
- **numbers** is 10
- **plural nouns** is 1146

- Totalling 1462 instances



INSTANCES OF AMBIGUITY

- Six instances of ambiguity identified
- Plural ambiguity did prove to be an issue in the three projects inspected
- The usage distribution of plurals is an indication that the REs were not paying attention to the usage of plurals and seem to be unaware of the dangers of the usage of plurals
- When the REs used plurals as a subject and or an object, context disambiguated successfully most of the times

INTERVIEW RESULTS

- The chief RE for each project was not aware of the ambiguities
- The entire team of REs had subconsciously disambiguated in the same way
- The chief REs do not believe that these ambiguities caused any problems in the subsequent downstream developments

QUESTIONS

CONTRIVED INTERPRETATION EXAMPLE

- Customers select at least one video for rental.
- **Interpretation A:** Each customer selected at least one video for rental.
- **Interpretation B:** Customers together select at least one video for rental.
- Domain knowledge tells us that interpretation B is contrived and that the intent is interpretation A.

SEMANTICALLY INDETERMINATE INTERPRETATION EXAMPLE

- The organization has opened a cleaning centre in Seward.
- **Interpretation A:** The organization has opened (a cleaning centre in Seward).
- **Interpretation B:** The organization in Seward has opened a cleaning centre.
 - The cleaning centre must be in Seward.
- Both attachments lead to the same interpretation.

MODIFIER PERSISTENT AMBIGUITY EXAMPLE

- Will only bring into System A those items needed to do X, Y, and Z.
- **Interpretation A:** Will bring into only System A those items needed to do X, Y, and Z.
 - Not into System B, etc.
- **Interpretation B:** Will bring into System A only those items needed to do X, Y, and Z.
 - Not other items into System A.

REFERENTIAL PERSISTENT AMBIGUITY EXAMPLE

- The encoding scheme will provide the ability to issue notifications of intrusions. The simple digest security scheme may be used as a direct replacement for the HTTP/1.0 basic authentication scheme with minimal modifications of clients and servers. This prevents security breaches.
- **Interpretation A:** The encoding scheme prevents security breaches.
- **Interpretation B:** The simple digest security scheme prevents security breaches.

ELLIPTICAL PERSISTENT AMBIGUITY EXAMPLE

- The database needs to be faster than System B.
- **Interpretation A:** The database needs to be faster than System B is.
- **Interpretation B:** The database needs to be faster than System B's database is.

CONDITIONAL CLAUSE REFERENCE

PERSISTENT AMBIGUITY EXAMPLE

- When a user requests a book with an available status, assign book to user. When a user requests a book with a checked-out status, place a hold on the book for the user. If so, increase the book's number-of-user-requests counter.
- **Interpretation A:** If a user requests a book with an available status, increase the book's number-of-user-requests counter.
- **Interpretation B:** If a user requests a book with a checked-out status, increase the book's number-of-user-requests counter.

PLURAL PERSISTENT AMBIGUITY EXAMPLE

- Module A summarizes corporate, charity, non-profit, and personal tax laws.
- **Interpretation A:** Module A summarizes corporate, charity, non-profit, and personal tax laws together into one summary.
- **Interpretation B:** Module A summarizes corporate, charity, non-profit, and personal tax laws into separate summaries, one for each category.

INSTANCES OF AMBIGUITY

- REs used standard placement 42 times out of 150
- REs for P3 used standard placement frequently, 34 times out of 35
- REs of P1 & P2 used standard placement less often
 - In P1, seven times out of 22
 - In P2, once out of 24

