Effects of Enhanced Compiler Error Messages in Rust: A Preliminary Study

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Rust

- A young systems programming language
  - Providing high performance similar to C/C++
  - Ensuring thread & memory safety

- Increasingly popular
  - Most beloved language in the last six years
  - Advocated by many big companies
  - Adopted in many important projects

Difficult of Using Rust

- Complex safety rules and strict compile-time check
  - Ownership & lifetime

- Error messages can be confusing

Online User Survey

- Goal: improve the effectiveness of Rust error messages in understanding the error
- Recruited Rust developers (N=52) from Rust forums (e.g., Rust User Forum)
- Participants were shown a Rust code snippet with varied error messages
- A 2 × 3 mixed design
  - One between-subject factor: enhanced type (solution, explanation)
  - One within-subject factor: error message (w/o, original, an enhanced type)
- Participants evaluated the error messages
  - Difficulty of root cause identification
  - Workload to comprehend using NASA TLX (Hart & Staveland, 1988)

Stimuli

- Original error message
- Enhanced solution
- Enhanced explanation

Results

Difficulty rating

- 3 (error message: w/o, original, enhanced)×2 (enhanced type: explanation, solution) mixed ANOVA
- Only the main effect of error messages was significant
- Post-hoc analysis: task with enhanced messages was rated easier than the original one

<table>
<thead>
<tr>
<th>Mean values of difficulty rating answers</th>
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<tbody>
<tr>
<td>w/o</td>
</tr>
<tr>
<td>Explanation (33)</td>
</tr>
<tr>
<td>Solution (19)</td>
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</tbody>
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NASA TLX (6 subscales)

- The main effect of error message was significant
- The two-way interaction of enhanced type and error message was significant
  - Enhancement by solution was more evident than that by explanation
- The main effect of subscale was significant
  - Higher ratings on performance

Conclusion

- Enhanced messages improve users’ understanding
- Enhanced solution is more effective than enhanced explanation

Future work: recruit more participants for more balanced data

References

Shuofei Zhu, Ziyi Zhang, Boqin Qin, Aiping Xiong, Linhai Song. 2022. Learning and Programming Challenges of Rust: A Mixed-Methods Study. Accepted in ICSE 2022