**This study is to understand the steps involved in error message comprehension from the Rust programmers’ perspective, and to elicit cognitive demands and skills required for comprehending Rust compiler error messages.**

**Rust programming Experience**

1.1 How long have you learned to program Rust?

☐ Have not learned at all

☐ 0 - 6 months

☐ 6 - 12 months

☐ 1 - 2 years

☐ 2 - 4 years

☐ more than 4 years

☐ Prefer not to answer

1.2 How often do you work with Rust?

☐ Rarely

☐ Monthly

☐ Weekly

☐ Daily

☐ Prefer not to answer

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**Phase 1 [Warm Up]**

2.1. What is your general impression of the Rust compiler messages in your daily Rust programming?

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**Phase 1 [Warm up]**

2.2. How would you describe the current Rust complier error messages as ``fixers’’ in your daily Rust programming? Do you find the error messages are very helpful, or not helpful at all, or somewhere in between?

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**Phase 1 [Think Aloud]**

2.3. Next, I would like you to walk me through a compiler error message of a Rust code snippet. Please continuously think out loud during this walk through— that is, simply verbalizing your thoughts as you move through the Rust compiler error messages.

* Please break the process down into three to six steps.
* For each step, I would like you to think about different courses of actions you might take, if any, and what possible mistakes someone with less Rust programming experience might make at different points in this snippet.
* Please identify which of those steps is the most cognitively challenging.

Here is some information to help you interpret what you see and describe what you might think or do.

**Situation**

What do you think is going on here? What is your assessment of the compiler error message of the code snippet?

**Actions**

What actions, if any, would you take at this point of time? How would you be using the compiler error message at this point?

**Critical cues**

What pieces of information led you to this situation assessment and action?

**Alternatives**

Are there any alternative ways you could interpret this situation? Are there any alternative courses of actions or modification to existing options? How did Rust compiler error messages figure in?

**Potential Errors.**

What errors would an inexperienced person be likely to make? Are there cues they would miss?

Are there ways the Rust compiler error message could confuse or mislead someone, or obscure important information?

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The following code cannot be compiled.

fn main() {

    let mut count = 0;

    let mut inc = || {

        count += 2;

    };

    for \_index in 1..5 {

        inc(); // line 2

        println!("{}", count); // line 1

    } // end

}

The Rust complier error message for the above code is as follows:

error[[E0502]](https://doc.rust-lang.org/stable/error-index.html#E0502): cannot borrow `count` as immutable because it is also borrowed as mutable

[--> src/main.rs:10:24](https://play.rust-lang.org/)

   |

4  |     let mut inc = || {

   |                   -- mutable borrow occurs here

5  |         count += 2;

   |         ----- first borrow occurs due to use of `count` in closure

...

9  |         inc();

   |         --- mutable borrow later used here

10 |         println!("{}", count);

   |                        ^^^^^ immutable borrow occurs here

error: aborting due to previous error

For more information about this error, try `rustc --explain E0502`.

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**Phase 2 [Semi-structured Interview]**

Now I want to ask you some questions about the steps that you described to comprehend Rust compiler error messages. I will ask you about different aspects of each step. You can give me some examples explaining why you think specific steps are challenging for you or others with less Rust programming experience than you. Also, some of your examples may apply more than one of the steps I will ask about, which is okay.