Data Collection and Analysis System for Workshop on Positive and Negative Syndrome Scale Instrument

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Summary

In this report, we designed a data collection protocol for gathering physician response data from workshops for the Positive and Negative Syndrome Scale (PANSS) instrument. We also designed a data analysis system to provide meaningful and fast feedback to the physicians at the end of the workshop. The main purpose is to quickly determine and present results on if physicians were successful in rating a patient on the PANSS instrument.

Introduction

The Positive and Negative Syndrome Scale (PANSS) instrument is used to assess the symptom severity of patients with schizophrenia under treatment. It is crucial to ensure the accuracy of the PANSS instrument rating, but training physicians can be a challenge due to potential errors in data entry, misunderstanding of questions, and delay of thorough feedback.

To address this problem, we implemented a digital system using Google Forms for data collection and RMarkdown for immediate analysis and feedback generation. This report details our streamlined methodology from data collection to data analysis and on the spot feedback generation for each physician. Google Forms facilitates the collection of data into a spreadsheet, minimizing errors and maximizing efficiency. Simultaneously, RMarkdown processes this data to produce workshop summary reports as well as personalized feedback reports for each physician, clearly indicating their training results.

Additionally, our analysis examines how language variations might impact the accuracy and effectiveness of the PANSS assessments.

Overall, this project demonstrates how the use of digital tools can make a difference in training by giving quick and insightful feedback, improving the effectiveness of PANSS instrument training.

Data Collection Protocol

For our data collection protocol, we utilized Google Forms to systematically gather information using a survey that mirrors the structure of the PANSS instrument.

To minimize data entry errors, almost all questions are formatted with multiple-choice responses. For the RATER variable, only positive identification codes are allowed to be entered. For the LANG variable, the available options are "E" (English), "F" (French), and "I" (Italian). For all other symptom ratings, respondents will choose from a scale of 1 to 7, with 1 labelled as 'low' and 7 labelled as 'high' to prevent confusion. Each question is required to be answered to successfully submit the form, which effectively eliminates any missing data.

The forms are linked directly to a Google Sheet which automatically formats responses into a data set, allowing for analysis and results ready well within 30 minutes. The platform ensures accessibility across devices, and built-in validation features help prevent incorrect or incomplete responses.

This protocol requires each physician to have a device to respond to the form, so extra devices can be leased or borrowed before the workshop for physicians without personal devices. Additionally, if Wi-Fi is unavailable, physicians can use mobile data or hotspots to continue completing the survey.

This approach to data collection via Google Forms linked to a Google Sheet allows for efficient and accurate gathering of data.

Data Analysis System

We used R and RMarkdown to program our data analysis system, linked in Appendix A, to generate summary and feedback documents. Users can run the system with the RStudio IDE, though proficiency with the software or the language is not required.

Explicit instructions for system usage are provided with the system in a README file. To summarize, the user moves the collected data set into the system directory before running the program and inputting a couple important pathname and filename parameters. The program then generates a summary document of the workshop alongside personal feedback reports for each rater.

If an accidental edit causes a data issue during transference of the data set to its proper location, our system changes all invalid symptom rating entries (anything except digits 1-7) to 10 to ensure any invalid entries do not contribute to a passing score. Also, in the case of a language entry that is not "E", "F", or "I", the entry is changed to "N" (None or NA).

To determine whether a physician passed or not, we use the following criteria: at least 5 of the 7 ratings for both positive and negative symptoms are within 1 of the expert's ratings, and at least 10 of the 16 ratings for generic symptoms are within 1 of the expert's ratings.

The first generated document is a workshop summary document named SummaryReport.pdf. It contains metrics on the number and percentage of physicians who passed and a general statement on whether language had a statistically significant effect on passing rate based on a Fisher's exact test performed at a 5% significance level. In addition, two stacked bar graphs display the proportion of correct ratings by symptom and the proportion of physicians who passed by language, with the latter serving as an additional visual assessment to the hypothesized significance between passing rate and language. An appendix lastly presents a data frame of the language and passing status of each rater for reference.

The other generated documents are personal feedback documents each named Phys#FeedbackReport.pdf, with # replaced by the physician's personal identification code. Each clearly denote at the top whether the physician passed or failed the workshop, proceeded by question-by-question feedback on whether their ratings were correct and how far their ratings were from the expert's ratings. A few pie charts help visualize performance per symptom category, and use of color allows physicians to more efficiently locate symptoms or categories with which they struggled.

Our data analysis system is successful because it easily provides detailed metrics concerning both workshop and individual performance with a focus on clarity, comprehensiveness, and the desires of each party involved.

Illustration of Data Analysis System

After running the system on the sample Panssdata.csv data set included with the system for practice by following the instructions in the README file, the previously defined workshop summary document and 72 personal feedback documents are generated. To avoid repetition, only segments of some files will be demonstrated.

First, we consider the results from SummaryReport.pdf, the generated workshop summary document. As shown in Fig. 1, 48 of the 72 raters from this workshop passed, resulting in a passing rate of 66.67%. In addition, the stacked bar chart indicates the vast majority of physicians struggled with rating symptom G16 (Active Social Avoidance), suggesting further emphasis should be placed on training physicians to recognize this symptom in future workshops.

Summary Report

2025-03-02

Section 1: General Results

Out of the 72 raters that attended this workshop, 48 raters passed and 24 raters failed.

66.67% of raters thus passed.

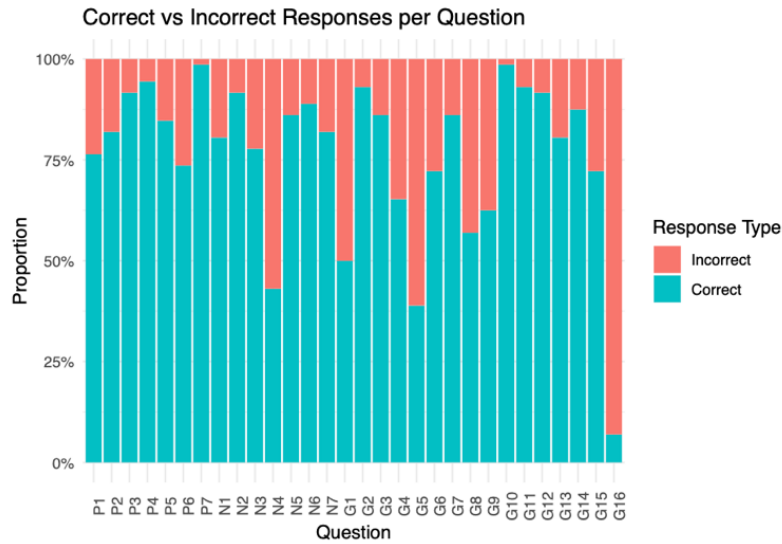Below are the per-question results, with correct responses being within one of the expert's ratings.

Fig. 1: First page of SummaryReport.pdf

Section 2: Effect of Language

There is not enough statistical evidence to suggest that language used significantly affects passing the PANSS training.

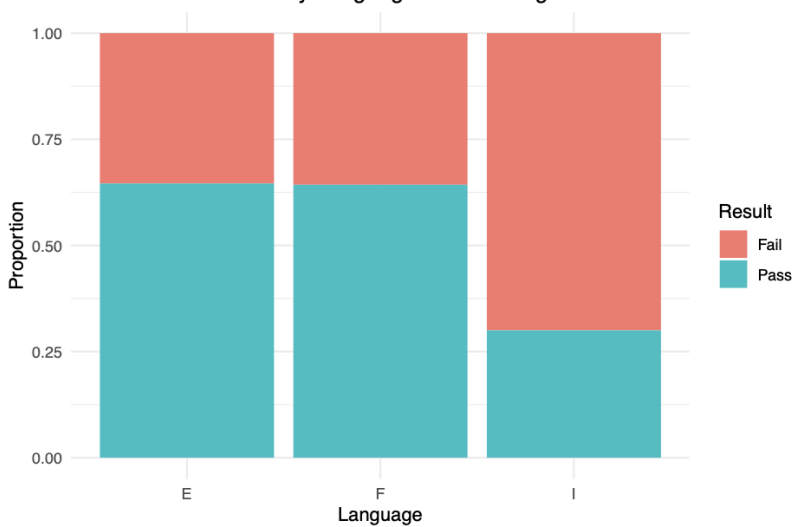For visual assessment, the chart below is included (E - English, F - French, I - Italian, N - NA).

Fig. 2: Second page of SummaryReport.pdf

As shown in Fig. 2, we are then informed that the performed statistical test indicated instrument language did not significantly affect passing the training; however, in the stacked bar chart also in Fig. 2, there seems to have been less raters that passed using Italian instruments compared to those using English and French instruments. The user conducting the analysis could now use both results to inform their judgement; for example, even though there was no statisticaly significant effect, we can still choose to investigate whether any issues exist with the provided Italian PANSS instruments.

Fig. 3 then shows an appendix at the end of the summary document containing the status and language of each rater included for reference. For example, we can quickly find that the physician with rater identification code 2 passed the training while using a French PANSS instrument.

Next, we consider the results from Phys1FeedbackReport.pdf and Phys3FeedbackReport.pdf, two generated personal feedback documents. In Fig. 4, we can immediately see that Physician 1 passed the workshop, and was even able to rate every negative symptom correctly, as shown by the corresponding pie chart; in contrast, in Fig. 5, we quickly notice that Physician 3 did not pass the workshop, having particularly struggled with rating general symptoms, as also shown by the corresponding pie chart.

Appendix A: Table of Results

```
##      RATER LANG Result
## 1        1    E   Pass
## 2        2    F   Pass
## 3        3    E   Fail
## 4        4    E   Fail
## 5        5    E   Pass
```

Fig. 3: Start of third page of SummaryReport.pdf

Feedback Report for Physician 1
2025-03-02

Section 1: Final Verdict

You PASSED the workshop!
Here are visualizations of how you did in each section:

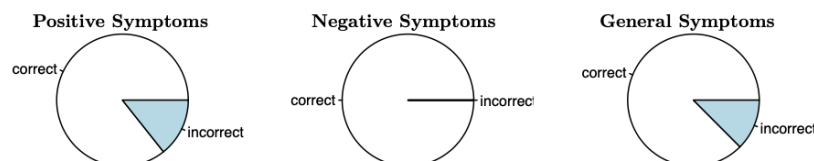
Fig. 4: First half of first page of Phys1FeedbackReport.pdf

Feedback Report for Physician 3

2025-03-02

Section 1: Final Verdict

You FAILED the workshop.
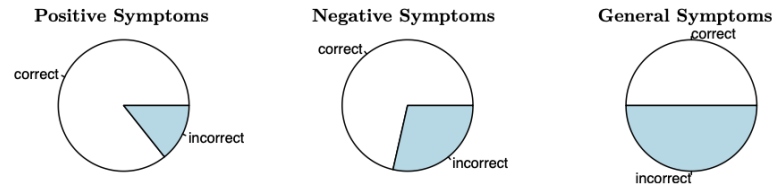Here are visualizations of how you did in each section:

Fig. 5: First half of first page of Phys3FeedbackReport.pdf

Section 2: Positive Symptoms

You got 6 out of 7 ratings for positive symptoms correct. This means you PASSED this section.

P1 - Delusions :
CORRECT (expert rating : 4 ; your rating : 3)

P2 - Conceptual disorganization :
CORRECT (expert rating : 2 ; your rating : 2)

P3 - Hallucinatory behavior :
CORRECT (expert rating : 5 ; your rating : 5)

P4 - Excitement :
CORRECT (expert rating : 1 ; your rating : 1)

P5 - Grandiosity :
CORRECT (expert rating : 2 ; your rating : 2)

P6 - Suspiciousness/Persecution :
INCORRECT (expert rating : 4 ; your rating : 2)

P7 - Hostility :
CORRECT (expert rating : 2 ; your rating : 2)

Fig. 6: Second half of first page of Phys1FeedbackReport.pdf

Moving onward with Physician 1's evaluation, Fig. 6 displays one of three sections detailing exactly which symptoms the physician was able to correctly rate. As expected by them passing the workshop, this physician performed well in rating positive symptoms, but the color-coded results highlight that they incorrectly rated P6 (Suspiciousness/Persecution). By viewing this report, the physician can quickly learn for which symptoms he can improve his rating abilities.

Conclusion and Recommendations

Our project successfully developed a digital data collection and analysis system for the Positive and Negative Syndrome Scale (PANSS) training workshops. By utilizing Google Forms for structured data collection and RMarkdown for analysis and presentation, we created a streamlined workflow that minimizes errors and provides immediate feedback to both workshop staff and participating physicians. The system efficiently determines whether physicians meet the passing criteria based on their ability to accurately rate symptoms in alignment with expert evaluations. Additionally, the structured multiple-choice format in Google Forms reduces data entry mistakes and ensures that all responses are properly recorded for analysis.

To further enhance the efficiency and security of feedback delivery, we recommend implementing an automated email system to distribute the personalized reports to each physician. This approach ensures that feedback is sent directly to the intended recipient, eliminating potential misidentification issues, and maintaining confidentiality. This can be achieved by modifying our [analyze_data()] function in R to include an automated email feature, or developing a third-party application in a different programming language which accomplishes the task. Implementing this functionality would complete the feedback loop, allowing physicians to receive their results promptly. Additionally, introducing user authentication for data entry could prevent accidental response duplication or unauthorized access, ensuring that each physician is correctly identified in the system.

Beyond feedback delivery, we suggest further improvements to data accessibility and training integration. A real-time performance dashboard displaying overall pass rates, average accuracy per question, and areas requiring improvement would enhance workshop engagement by allowing facilitators to address common errors immediately. Integrating the system with existing medical training platforms or continuing education programs could provide physicians with long-term progress tracking and skill improvement opportunities. Finally, a mobile-friendly version or a dedicated app could increase accessibility, allowing physicians to complete training conveniently on their own devices. These enhancements would further improve the accuracy, security, and usability of the PANSS training system, making it more efficient and scalable for future workshops.

Lastly, despite the PANSS instrument's availability in multiple languages, the generated documents are only written in English. Further collaboration with translators could allow for generation of feedback documents in languages which match the used instrument's language; however, if this cannot be arranged, a couple on-site interpreters at the workshop could clarify details for those who can't read English, while the documents' usage of universally understood visualizations and colors would convey general performance information to anyone.

Appendix A: Relevant Links

The following link provides access to the ZIP file containing the data analysis system:

https://drive.google.com/file/d/1h5_TOVxmKevuQukjQ3btkv7yGi4fU4U0/view?usp=sharing

The following link provides access to the Google Form detailed in this report for data collection:

https://docs.google.com/forms/d/1dMCvbt4NAv_WhOnwMyCQqF3sUkdWJcJfHbJDYaB8rZs/edit

The following link provides access to the Google Sheet connected to the Google Form which will fill with response data:

https://docs.google.com/spreadsheets/d/1y07GA4rfOQwiNXdNF7N68AxABlYx91AiJmmvhgfkaHA/edit?resourcekey=&gid=1976128601#gid=1976128601