User Feedback on Plain Language Summaries: A Qualitative Study in a German General Population Sample

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Abstract Plain Language Summaries (PLSs) describe scientific studies in a lay-friendly way to support public understanding of scientific evidence. This study investigates user feedback on PLSs based on a conceptual PLS framework. Our aim was to explore the users' perspective on PLSs and to verify whether the topics named by users correspond to the conceptual framework categories. In an online study, we presented German PLSs of psychological studies to participants. They were asked for their feedback in three open questions. We received 2032 responses from 1098 participants, which were coded by two raters based on the conceptual framework. Participants had homogeneous views on some topics (e. g., the content of the PLSs). These results provide direct clues for users' expectations towards PLSs. We observed diverging views on other topics (e. g., text length). These results indicate different needs among users. We conclude that a good fit between PLS and target group is important. The presentation of PLSs should allow users to choose information according to their needs. Finally, not all of the framework's categories were mentioned by the participants. Implications of this finding are discussed.

Keywords plain language summaries, public understanding of science, science communication

1 Introduction

Technical language is part of scientific publications in all disciplines. Oftentimes, scientists develop jargon that is only understandable for experts in their special field. It diverges in many ways from common language (Kretzenbacher 1998, Weinrich 1998). The content of scientific publications, however, is relevant and interesting to a wider audience beyond scientific experts. This is all the more important as digital media with their various platforms are becoming an increasingly popular resource for knowledge (Brossard 2013, Peters et al. 2014). Encountering fake messages, conspiracy theories or pseudo-scientific content on these platforms is not uncommon (De Coninck et al. 2021, Pennycook/Rand 2021). Scientific publications may seem less attractive and accessible to those not involved in the scientific community, especially when compared to the abundance of information that is readily available through digital media (Khan/Brohman/Addas 2022). To enable non-scientists to gain knowledge based on scientific findings, a viable way could be to present the information in a less technical but more engaging and comprehensible manner. Therefore, science communication as a means to enhance the public understanding of science receives growing attention.

To use Hoffmann's (1984) parameters adapted by Czicza/Hennig (2011), this kind of communication occurs in the milieu of knowledge transfer outside of universities, under partici-

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pation from both scientists and laypersons. It requires researchers to adapt their language and to shift their perspective. As a science communication offer and as a way of communicating scientific studies in text form in a generally understandable way, Plain Language Summaries (PLSs) have been introduced. PLSs have been subject to empirical investigations, but this research field is still in its early stage. There are diverging ideas of how a (good) PLS should look like. For this reason, our research group developed a conceptual framework with 12 categories depicting a researcher's perspective on PLSs based on theory, empirical findings and writing guidelines (Stoll et al. 2022). In our study, we explored the users' perspective on PLSs and verified whether their feedback to PLSs corresponds with the categories represented in the conceptual framework. Our research questions were: How do users perceive PLSs of psychological meta-analyses? Which features are of particular relevance for them? To what extent do the topics mentioned by the users fit the categories identified in the researchers' framework model?

1.1 Plain Language Summaries (PLSs)

PLSs are short, lay-friendly summaries of scientific evidence. They have been established as complements to scientific abstracts, mainly in the medical sciences (FitzGibbon et al. 2020), but also in other disciplines (e. g., Shailes 2017, Hauck 2019). In the psychological sciences, PLSs are still nascent. Yet, psychological evidence is becoming increasingly important for decision-makers as well as for the general population, for example regarding behavioral or decision-making processes in the context of climate change (Clayton et al. 2015, Van Lange/ Joireman/Milinski 2018) or pandemic events (Karayianni et al. 2022). But although PLSs are important for the communication of research (Kuehne/Olden 2015, FitzGibbon et al. 2020), there is no consensus on what distinguishes a good PLS from a bad PLS. As our literature review has shown, writing guidelines for PLSs as well as empirical evidence on PLSs' effective-ness are heterogeneous (Stoll et al. 2022).

1.2 Research on PLSs

Quantitative research has shown advantages of PLSs over graphical abstracts, scientific abstracts (Anzinger/Elliott/Hartling 2020), and systematic reviews (Opiyo et al. 2013). Comparisons of different versions of PLSs have further provided evidence for a superior performance of PLSs with medium text difficulty compared to PLSs with a low or high text difficulty (Silvagnoli et al. 2022). Qualitative research on PLSs mainly evaluated current PLS formats and identified potential needs for improvement (e. g., Brehaut et al. 2011, Busert et al. 2018). However, the studies examining PLSs are heterogeneous in their assumptions of what defines them. The investigated PLS formats differ greatly in their characteristics, such as text length and content. Additionally, the examined target group varies, which has implications for the design and aims of PLSs. For these reasons, it is difficult to compare the results of the studies. The empirical literature clearly demonstrates a variety of perspectives on PLSs, which is further reflected by the diversity of guidelines for writing PLSs (Stoll et al. 2022). This heterogeneity suggests that researchers may have different assumptions and concepts regarding the purpose, usefulness, and the users or target audience of PLSs.

1.3 Conceptual framework

To elaborate overarching structures and underlying similarities in this research field, our group developed a conceptual framework structuring the literature on PLSs (Stoll et al. 2022). It also aims to be a comprehensive tool for analyzing PLSs and encompasses categories for the questions "What purpose do PLSs serve?" (PLS-aims) and "What do PLSs consist of?" (PLS-characteristics). The framework connects these theoretical categories to elements of PLS-research (i. e., outcomes of studies on PLSs) and PLS-policy (i. e., criteria of PLS guidelines).

Six categories are proposed to represent *PLS-aims*:

- 1. The category *Accessibility* describes that PLSs should aim for a low threshold, both in terms of technicality and content.
- 2. The category *Understandability* is concerned with the content-related comprehensibility of the research questions, methods, and results.
- 3. The category *Knowledge Acquisition* describes all formulated aims of PLSs that involve laypeople acquiring knowledge based on scientific evidence.
- 4. The category *Empowerment* focuses on the aim of promoting self-determined, science-based decision-making.
- 5. The category *Communication of Research* outlines the more abstract aims that involve the dissemination of scientific content.
- 6. The final category *Improvement of Research* describes the aim of advancing research itself and research practices.

Furthermore, the framework proposes six categories representing *PLS-characteristics*:

- 1. The first category *Linguistic Attributes* includes language-related features, such as the tone or word choice.
- 2. The category *Formal Attributes* encompasses formal structure and formal features (e. g., text length).
- 3. The category *General Content* details both content structure and content characteristics. Further categories focus on the
- 4. Presentation of Results,
- 5. *Presentation of Evidence Quality* (e. g., whether the PLS names authors' conflicts of interests), and
- 6. *Contextual Attributes* (e. g., information about the writing or publication process).

1.4 Capturing users' perspectives

What are other frameworks for user experience and how have they been used to capture users' perspectives on PLSs? One particularly relevant framework is Rosenbaum's (2010) framework for user experience for evidence, which is based on Morville's (2004) reflections. From a designer's perspective, Morville's (2004) model of a "user experience honeycomb" provides seven facets: *useful, usable, desirable, findable, accessible, credible, valuable.* According to the author, the model is a tool to advance the conversation beyond usability, and to demonstrate the topics people need to consider if they want to design products in terms of user experience. The "user experience honeycomb" therefore is a tool developed from a practitioner's perspective to speak about user experience. Rosenbaum (2010) investigated users of scientific evidence and revised the honeycomb model based on her empirical findings by removing the facet "valuable" and adding the facets "understandability" and "affiliation". She also included the dimensions of time and motivation, which she named "recognition", "exploration", and "reliance". Thus, Rosenbaum used Morville's honeycomb model and an empirical approach to develop a framework model for user experience of scientific evidence. Building on Rosenbaum's (2010) framework, Busert et al. (2018) conducted an empirical user experience study with the aim of developing a summary format suitable for public health-decision makers in German-speaking countries. They applied the think-aloud method and categorized participants' answers via Rosenbaum's (2010) facets. Based on the results of their analysis, they were able to make adaptations that favorably influenced the user experience of their summary format. Busert et al. (2018) thereby exemplified how to use and adapt a user experience framework for coding qualitative data on evidence summary formats.

1.5 Study aim

In our study, we adopted the methodical approach applied by Busert et al. (2018) to investigate user feedback on German PLSs of psychological meta-analyses. We used the conceptual framework by Stoll et al. (2022) to explore the users' perspective. This model, in contrast to the models mentioned above, is characterized by its development based on the scientific literature on PLSs from a researcher's point of view. Yet, it is unclear whether the framework adequately represents the user perception of laypersons when reading PLSs. In our study, we thus conducted a qualitative analysis of user feedback gathered in an online-experiment with N = 2451participants from the German general population. Our aims were to include the user perspective in the picture, to find out how users experience PLSs and to learn more about features that are particularly relevant for them. To that end, we evaluated users' feedback data via a qualitative structuring content analysis and examined how often particular topics were mentioned. Finally, we also investigated the fit between the user feedback and the conceptual framework.

2 Methods

2.1 Context

This study is part of the project "PLan Psy", which aimed at developing an evidence-based guideline for writing German PLSs of psychological meta-analyses. The user feedback investigated in this study was taken from the project's third experimental study, for which a general-population sample (N = 2451) stratified by age, education level and sex was recruited (Kerwer et al. forthcoming). Participants received two research summaries of the same style on two distinct topics. The summaries were either written in the style of PLSs or scientific abstracts.¹ The research summaries reported results from meta-analyses on the topics of different psychotherapy interventions for the treatment of depression (Cuijpers et al. 2008, Barth et al. 2013) and on the positive effect of videogames on various domains of cognition (Bediou

¹ The type of information included in these summaries varied depending on the experimental condition. The summaries varied in the reported number of effects, in the presented information on conflicts of interest, publication bias and whether a statement on practical relevance of scientific findings was shown. The aim of the experimental study was to investigate the effects of these features on a priori defined outcomes (e. g., content-related knowledge, epistemic trustworthiness).

et al. 2018). We asked participants for feedback on the summaries via voluntary answers to open-ended questions, and will provide analyses of these answers in the current study. All study procedures were approved by the Ethics Committee of Trier University.

2.2 Data

2.2.1 Data collection methods

The study was conducted online using the survey software Unipark (www.unipark.com) in October and November 2021. The large general population sample was obtained via the panel provider "Bilendi & respondi" (www.bilendi.de). Answering the open-ended feedback questions was not mandatory for completing the survey.

2.2.2 Data collection instruments and technologies

User feedback was collected using the following general instruction: "To conclude our survey, we are interested in your opinion on the survey content. It would be great if you could help us to further develop our service. In this way, the wishes and needs of future readers can better be taken into account." This was followed by three open-ended questions, which each allowed participants to enter an answer (no word limit) into a textbox:

- "What did you like about the summaries? We want to continuously improve our summaries. Your feedback can help us in doing so. Feel free to highlight positive aspects here."
 We call information gathered from answers to this question *positive feedback*.
- "What did you not like about the summaries? We want to continuously improve our summaries. Your feedback can help us in doing so. Here you are welcome to write what we could improve in the future." We call information gathered from answers to this question *suggestions for improvement*.
- "What else would you like to tell us? Here is space for anything else you might want to share with us." We call information gathered from answers to this question *additional feedback*.

2.2.3 Units of study

For the qualitative content analysis of the study, we only considered user feedback on PLSs, not on scientific abstracts. From the 2451 study participants, 2256 completed the survey. Of these, 497 participants were assigned to read scientific abstracts and therefore excluded from our qualitative analysis. Thus, 1759 participants assigned to read PLSs remained. These participants had the option of answering none, one, two or three of the open-ended questions described above. Response fields left blank were not considered in the further coding phase. Data from participants who answered none of the three questions were excluded from the qualitative analysis. After this removal, 1217 participants with 2817 responses were included in the qualitative analysis. During coding, we found 785 meaningless responses (e. g., "Ndnfnf", "xxx", "…"). After removing these responses, our final dataset contained 2032 responses from 1098 participants. There were 978 positive feedback responses, 870 suggestions for improvement, and 184 additional feedback responses.

2.3 Researcher characteristics and reflexivity

The first author (Marlene Stoll, MS) was involved in the design and execution of the experimental study that, among other variables, collected the qualitative data analyzed here. MS is also the primary author of the systematic review for the underlying conceptual PLS framework. To have independent and unbiased raters coding the data, Michelle Bähr (MB) and Eva Becker (EB) coded the feedback answers. Aside from being involved in the larger project, they had not been involved in designing the experimental study or in developing the conceptual framework.

2.4 Analysis and trustworthiness

2.4.1 Analysis

To meaningfully summarize and interpret the feedback content, we wanted to find a comprehensive and economical representation by leaning on the framework categories (Qualitative Content Analysis according to Mayring 2014). To achieve this, EB and MB used the 12 categories of the conceptual framework by Stoll et al. (2022) as a coding system to categorize 100 feedback answers in an initial inductive phase. EB, MB and MS then reviewed the results of this initial phase and revised the coding system by adding new subcategories.

In the following second pilot phase, EB and MB coded 200 items with the revised system. This revised coding system was again checked by EB, MB and MS, and final adjustments were made. The resulting set of categories formed the final coding system. Final coding of all answers was carried out by EB and MB. Depending on the type and quantity of addressed topics in the feedback answers, the coders assigned between one and three categories for each answer. For example, the feedback response "clear presentation and interesting results" was assigned to the categories *Formal Display* and *General Content* and no third category, because the two categories exhaustively covered the content of the response. After all feedback responses were coded, EB and MB compared their categorizations and resolved discrepancies via discussions. If a consensus could not be reached, agreement was obtained via consultation with MS. For the final evaluation, the results were interpreted narratively and frequencies of each category and subcategory were counted.

2.4.2 Categories

The final set of categories can be seen in Figure 4 (see below in section 3.4.6) and Table 1 (see Appendix). The 12 PLS-aims and PLS-characteristics categories of Stoll et al. (2022) provided the basic framework and initial coding system for this study. After the first and second pilot phase, the final set of categories comprised 2 unspecific main categories and the 12 main categories provided by the initial system. These branched further into 19 subcategories.

2.4.3 Techniques to enhance trustworthiness

To ensure the credibility of the data analysis and methodological integrity, two researchers (EB, MB) reviewed the data. Results were discussed by all study authors. Our results are reported in accordance with the Standards for Reporting Qualitative Research (SRQR, O'Brien et al. 2014).

3 Results

3.1 Sample

Our sample included 2032 analyzable responses by 1098 participants. The longest responses contained 350 (positive feedback), 1003 (suggestion for improvement) and 1235 characters (additional feedback). Of the 1098 participants who provided feedback responses, 566 (52 %) were male and 532 (48 %) female. The mean age was 49 years (Range: 18–85, SD = 15.5). Of all participants, 392 (36 %) had "Abitur" (higher track, German university entrance qualification), 375 (34 %) a "Realschulabschluss" (middle track), and 331 (30 %) a "Hauptschulabschluss" (lower track). Inclusion criteria for the study were: (1) German language skills at native speaker level, (2) secondary school graduation, (3) no degree in psychology, (4) no psychology student, (5) at least moderate interest in psychological research (4 or higher on an 8-point Likert scale for the item "I am interested in psychological research.", 1 = fully disagree to 8 = fully agree).

3.2 Unspecific categories

The unspecific feedback categories include responses that generally praise or criticize PLSs without mentioning concrete content. Responses were assigned to the general categories *in favor of the PLS* (e. g. "all good", "no improvement needed")² and *to the disadvantage of the PLS* (e. g., "nothing good", "everything needs to be improved"). Overall, there were 529 unspecific feedback responses in favor of the PLSs, a share of 26 % of all 2032 responses, and 54 (3 %) unspecific feedback responses to the disadvantage of the PLSs (Figure 1).



Figure 1: Number of unspecific feedback responses, split into positive feedback, suggestions for improvement and additional feedback

² All answers were given in German but were translated to English for this publication.

3.3 Specific categories: PLS-characteristics

The specific feedback categories include responses with concrete content. Responses that mentioned PLS-characteristics were classified into six PLS-characteristics categories, which are shown in Figure 2 and which are described in detail with examples below.



Figure 2: Number of specific feedback responses in "PLS-Characteristics" main categories, split into positive feedback, suggestions for improvement and additional feedback

3.3.1 Linguistic attributes

The category *Linguistic Attributes* was the second most frequently mentioned main category, with 536 responses (Figure 2, see above). We identified five subcategories: *General Linguistic Attributes, Comprehensibility of the Language, Use of Technical Terms, Use of Gender-Neutral Language,* and *Sentence Structure.* Participants' comments on *General Linguistic Attributes* of the PLSs were, for example, that the texts were "clearly and concisely written" or that they were "written a bit strange". *Comprehensibility of the Language* received comments such as this typical response to the positive feedback question: "Simpler (but not overly simple) language has been used that conveys the key messages of the study to a layperson like me", while a typical suggestion for improvement was: "Too many incomprehensible explanations, it would be better to use universal expressions."

The *Use of Technical Terms* was mainly criticized and garnered less praise. Participants complained that the text contained technical terms that were not self-explanatory and that terms appeared that "are not known by a person who did not attend university". One exemplary positive feedback response was that the person was "positively surprised because I was concerned that too many technical terms are in it. This was not the case". The *Use of Gender-neutral Language* was solely mentioned negatively, for example: "the gender-neutral terms unfortunately disrupted my reading flow. I considered stopping reading", "I think that gendering in scientific texts is nonsense!". Lastly, regarding the *Sentence Structure*, it was positively mentioned "that the sentences were not so long", while it was also criticized that there were "too many, too long sentences that you had to read as a normal person who did not attend university".

3.3.2 Formal attributes

The main category *Formal Attributes* was the third most commonly named main category in the feedback answers, with 382 responses. We identified three subtopics: *General Formal Attributes, Text Length* and *Formal Display. General Formal Attributes* were mentioned positively in responses stating that the texts were "well structured" or "well comprehensible, such as the same order of mentioned parameters and the content statements". A typical suggestion for improvement was that the PLSs were "somewhat unclearly structured, a few highlights or graphics would have been good".

The second subtopic that emerged was *Text Length*. An exemplary positive feedback emphasized "short and concise information on an important topic that can be easily read and understood in a few minutes". Suggestions for improvement included responses on the text being too long ("There was too much text, I was totally staggered") as well as too short ("For me personally, they were too short, i. e. I like to have more detailed information on psychological topics. Psychological topics are so complex that they actually seem too superficial in a short version"). We observed more responses on the text being too long (*n* = 69) than too short (*n* = 15). The third subtopic was *Formal Display*. It was positively mentioned, for example, that the text was "clearly designed". Suggestions for improvement were more specific, for example: "The central points should be highlighted in bold and/or italics. This makes reading easier and focuses on the central points".

3.3.3 Content

The most frequently mentioned main category was *Content* with 583 responses. We identified the three subtopics *Content in General, Amount of Information in the PLSs* and *Interest in the Topic of the PLSs*. Positive and additional feedback responses on *Content in General* outlined that the content was an "illumination of topics on which I had not previously focused my attention" or that "the topics were well chosen". There were fewer suggestions for improvement. For instance, they stated that it was "boring that only one key statement was ever made and nothing else was elaborated upon". The *Amount of Information in the PLSs* was a subtopic on which participants expressed polarized opinions. Some participants commented positively on the high amount of information (e. g., they valued "that a lot of information on a topic was given"), while others commented that there was too much information in the PLSs (e. g., "borderline much input in a short time", "too much information at once to process quickly"). Contrastingly, participants also commented positively on the low amount of information, and at the same time others commented that there was too little information (e. g., "they could have gone into a bit more depth", "there was little background information, [...] more details/ info on the respective studies would have helped").

There were also responses describing the amount of information as just right (e. g., "Very well to the point and even a layperson could understand the subject matter", "The summaries are short and understandable. Important things are included. Unimportant things are not

mentioned"). In sum, we found more responses requesting more information (n = 40) than responses requesting less information (n = 12). Another subtopic in this category was the *Interest in the Topic of the PLSs.* There were few suggestions for improvement mentioning a personal lack of interest (e. g., "it is not my field of interest!"). Among the positive feedback responses, participants mentioned, for example, that "[t]he studies are interesting. And you also learn things that you don't hear otherwise".

3.3.4 Presentation of results

The main category *Presentation of Results* was mentioned in 106 responses. We identified no additional subcategories in the investigated responses. Positive feedback responses included praise for "the brevity and the overview of the most important results", or that "the valence of the Cohen value was always given in parentheses, so you knew right away how to understand the value". Suggestions for improvement were more frequent than positive feedback. The suggestions for improvement often commented that the numeric values and the measurement units were confusing (e. g., "I'm not sure if people with a lower level of education [...] can handle the units of measurement used (Cohen's d) or if they don't get off when reading there. Perhaps there is another way to explain it"). The additional feedback responses were also mostly critical (e. g., "Communicate the results in a less complicated way and in simple understandable words!", "Instead of texts, I would like to see the results listed in tabular form").

3.3.5 Presentation of quality of evidence

Presentation of Quality of Evidence was mentioned in 9 feedback responses only. There were 2 positive feedback responses praising transparency. Apart from that, responses were critical (e. g., that "nothing was said about the quality of the studies"). One participant wrote: "Are the studies real? I found the second one very questionable. [...] Was the time factor of use taken into account? Who funded the study?".

3.3.6 Contextual attributes

There were 17 responses that we could categorize into the main category *Contextual Attributes.* No additional subcategories were necessary in this main category. Most responses commented on missing sources (e. g., "Overall, I find the meta-analysis good, but it does not disclose with any footnote which studies it has taken into account", "Links for the studies would be interesting. So that you can read everything again in detail"). Also, participants lacked information about the authors (e. g., they did not like "that it is not stated who exactly wrote the meta-analysis").

3.4 Specific categories: PLS-aims

Responses that mentioned PLS-aims were classified into six PLS-aims categories. These categories are shown in Figure 3 and described in detail with examples below.



Figure 3: Number of specific feedback responses in "PLS-Aims" main categories, split into positive feedback, suggestions for improvement and additional feedback

3.4.1 Accessibility

There were 338 responses in the main category *Accessibility*. We could not rationalize the creation of additional subcategories here. Some participants mentioned positively that the texts are accessible for non-experts (e. g., "That attempts are being made to bring people like me, too, closer to such studies"). Other participants used the questions on suggestions for improvement or additional feedback to emphasize a lack in text accessibility or attractiveness for people with lower level of education (e. g., "For people with low education and not affected, certainly difficult to read and interpret," "quite overwhelming for non-experts. Maybe you should change the target audience").

3.4.2 Understandability

The main category *Understandability* was mentioned in 246 responses. We specified three subcategories: *Understandability in General, Understandability of the Scientific Method*, and *Understandability of the Results*. See Table 1 (Appendix) for frequencies of responses categorized to these subcategories. Responses on *Understandability in General* appeared both in the positive feedback responses (e. g., "was quite understandable for laypersons") and the suggestions for improvement (e. g., "Well, a secondary school student won't understand it.", "For a layperson the summaries were not so easy to understand. It's more for psychologists").

Regarding the *Understandability of the Scientific Method* and the *Understandability of the Results*, we observed divergent opinions. On the one hand, participants commented that they "find that the summaries help laypersons better understand the complex study and results. A study is often complicated and hard for outsiders to understand. The results have been simply

represented here". On the other hand, participants criticized the lack of understandability: "Too many numbers where hardly anything was understood" or "The results are confusing. I didn't understand what follows from the summary".

3.4.3 Knowledge acquisition

There were 45 responses containing content assigned to the main category *Knowledge Acquisition*. No subcategories were identified. In sum, participants liked that they could learn something by reading the PLSs. One participant commented: "I found the summaries very good. Even as a layperson in the field, I was able to comprehend the facts and thus also acquire new knowledge", another wrote: "Anyone who is interested in the subject matter was able to learn something here". Suggestions for improvement underlined that there was not enough information to learn something and that the users would need to know more about the details to learn something new.

3.4.4 Empowerment

Further 57 responses have been assigned to the main category *Empowerment*. We saw the need for two subcategories: *Empowerment in General* and *Personal Relevance*. Examples for *Empowerment in General* responses were: "The studies help to see certain issues more simply, or to act more explicitly on problems!" and "The results in short sentences in simple language can help people who are not familiar with the subject. For example, in finding the answer whether to start psychotherapeutic treatment or not". One rather critical response was that the PLSs contained too little information to have a say on the topic.

The second subcategory was the *Personal Relevance* of the topic and the attractiveness or usefulness resulting from it. Participants wrote that the "first topic concerns me privately, therefore interesting" and that they "found both topics very interesting because the topics affect me personally". However, there were also negative comments (e. g., "I did not find the first study so exciting because it did not affect me directly", "The summaries are certainly good, but not relevant for me").

3.4.5 Communication of research

We assigned 73 responses to the main category *Communication of Research*. Three additional subcategories were identified: *Communication of Research in General*, *Opinion about Psychology*, and *Credibility of the Study*. The subcategory *Communication of Research in General* includes responses from participants who liked that "one has received new knowledge about the preparation of scientific work in relation to studies" and that "for a layperson like me, this is a whole new field of how the psyche is actually composed and how the studies are done".

The second subcategory was participants' *Opinion about Psychology*, which occurred mostly in suggestions for improvement or additional feedback. For instance, one participant demanded that "a good psychologist should deal less with books and venture out among the people". The third identified subcategory was the *Credibility of the Study*. It was positively mentioned that "it has been honestly described what exactly has helped and what has not" and that it "appears unbiased". However, it is noteworthy that there was a comparatively high number of suggestions for improvement that included doubts about the credibility or scepticism

(e. g., "I can't imagine that the second study was done properly," "The summaries only go in the direction that the people concerned want in order to strengthen or confirm their so-called analyses. Most of the time they do not correspond to reality [...]. Results which do not correspond to the conceptions are dropped under the table and do not appear accordingly. They would reveal that the results are not as they are presented").

3.4.6 Improvement of research

No feedback response could be assigned to the category *Improvement of Research*. An overview of all categories and subcategories with examples is provided in Figure 4.

4 Discussion

4.1 Key findings

The aim of this study was to analyze user feedback on PLSs and to examine whether this user perspective fits the conceptual framework (i. e., the researcher perspective) on PLSs (Stoll et al. 2022).

4.1.1 User feedback on PLSs

In the analysis of the user feedback on PLSs, we observed that over 25 % of responses were unspecific feedback in favor of the PLSs, showing us that a large number of users were generally satisfied with the summary format. Additionally, there were many more detailed feedback responses. On some topics, there was high overall agreement among participants. For example, many commented positively on the content of the PLSs or made suggestions for the use of technical terms. Other topics were mentioned both positively and negatively ("ambivalent topics"). These are characterized by strong opinions both on positive and negative sides of the framework category, for example for the subcategories Text Length or Amount of Information. Overall, the categories with the highest number of responses were General Content, Linguistic Attributes, Unspecific Category in Favor of the PLSs, and Formal Attributes. Answers related to the main categories Accessibility, Understandability, and Presentation of Results were moderately frequent. We observed comparatively few answers in the main categories Knowledge Acquisition, Empowerment, Communication of Research, and (almost) no answers in the main categories Quality of Research, Contextual Attributes, and Improvement of Research. We therefore conclude that users initially form their impression of the PLSs by evaluating the general appearance and content of the PLSs and pay less attention to PLS-aims or more detailed PLS-characteristics.

4.1.2 Conceptual framework fit

The conceptual framework was comprehensive enough for categorizing the participants' feedback answers, but not exhaustive. The framework's main categories covered all PLS-aims and PLS-characteristics that were named in the feedback responses. We formulated 19 subcategories (8 for PLS-aims and 11 for PLS-characteristics) to better represent the details in the feedback responses. It was further necessary to introduce two new main categories for *Unspecific*



Fachsprache Vol. XLVI 1-2/2024

- 53 -

Feedback Answers in Favor of the PLSs and Unspecific Feedback Answers to the Disadvantage of the PLSs to capture broad feedback answers given by many participants.

Some framework categories were only rarely or not at all mentioned in the user feedback responses. For example, participants in our study seldom named topics belonging to the *Presentation of Quality of Evidence* and the *Contextual Attributes* categories, and topics from the PLS-aims-category *Improvement of Research* were not mentioned at all. We interpret this as a sign that these categories of the conceptual framework are less salient for the target group of the PLSs, and more salient from a theoretical viewpoint taken by authors of PLSs or writing guideline developers. Overall, the conceptual framework turned out to be a suitable basis for assessing and structuring qualitative user feedback on PLSs.

4.2 Comparisons with previous work

The findings of this study are mostly in accordance with previous studies on PLSs. The topics mentioned by users in this study coincide with topics identified in previous studies. For example, our findings are in line with Brehaut et al.'s (2011) findings from a user feedback study on consumer summaries of Cochrane reviews: They identified the amount of detail, layout and language, source credibility, and preparation for decision-making as user relevant topics. These topics were also mentioned by our study participants. Our finding that participants commented mainly negatively on the presentation of results matches research from Buljan et al. (2020): They examined consumer preferences for different summary formats and found several problems in readers' understanding of uncertainty. Lastly, previous studies on research summaries for decision-makers have also found ambivalent topics. This is in line with our observations that participants reported diverging views on certain topics, for example regarding text length or depth of information (Dobbins et al. 2007, Ellen et al. 2014, Mijumbi-Deve et al. 2017, Busert et al. 2018).

4.3 Strengths and limitations

A strength of our study is that data were generated using a large sample of participants with diverse age, gender, and education level. Additionally, the employed category system was built on a conceptual framework drawn from a rigorous systematic review of PLSs literature. However, there are also limitations to consider. First, participants were only able to give short answers or skip the feedback process entirely. Since providing feedback was not necessary to complete the study, this may have introduced biases. For instance, only participants already highly interested in the PLSs may have felt inclined to provide feedback responses. Second, the open question format did not name specific PLS aspects, such as evidence quality. Users may have thus mentioned these less publicly discussed aspects less frequently. This does not mean that these topics are less relevant from a user's point of view, but simply less salient. Third, we did not randomize the presentation order of the questions. Readers always received the positive feedback question first, which may explain the higher rate of positive feedback compared to suggestions for improvement or additional feedback. The motivation to answer may have decreased over time. Fourth, due to the experimental study design, the amount of information presented in the PLSs varied between participants (cf. also Kerwer et al. forthcoming). Focusing on a single PLS for all participants would have allowed us to interpret feedback more specifically. For instance, if all participants had read a PLS on the topic of psychotherapeutic interventions for depression, and the PLS reported one effect and no conflict of interest, we would have greater confidence in the participants' shared opinion on that specific PLS and its characteristics. When interpreting the findings of our study, it is therefore important to keep in mind that the participants spoke about PLS versions that varied slightly in their characteristics. Simultaneously, this may have positively impacted the generalizability of our findings. The study obtained views on different PLSs, for example, PLSs reporting one or four effects and PLSs reporting or not reporting a conflict of interest. In reality, these characteristics will vary among PLSs, so the responses in the study provide an initial indication of the impressions that different PLSs will make on their readers. Lastly, it is important to keep in mind that our results are only based on participants with at least moderate interest in psychological information, as defined by the inclusion criteria.

4.4 Meaning of the findings and implications

4.4.1 User feedback on PLSs

As described above, participants had homogeneous views on certain categories. These views provide us with implications for further improvement of our PLSs. For example, we should maintain our choice for the content of the PLSs. We also identified critical PLS-characteristics where participants universally reported difficulties or claimed need for improvement (e. g., the *Use of Gender-Neutral Language*, or the *Presentation of Results*). This indicates that these topics are relevant and worth considering when communicating (psychological) scientific evidence to laypersons. In terms of practical relevance, PLS writers or policy makers may use these findings to improve PLSs to increase their usefulness.

We were further confronted with the fact that over a quarter of the answers fell under the category *Unspecific in Favor of the PLS*. Examples of typical responses to the question "What did you like about the summaries?" that fit this category include "Was all right", "all good", or "everything". This raises the question of whether these participants were genuinely satisfied with the PLSs or whether there were other reasons for their response. Answering the question was optional, so participants could have skipped it if they had nothing more to say. Instead, one explanation could be that the participants reported a holistic view instead of naming specific aspects of the text because they perceived the PLS as a whole and remembered the overall impression rather than specific content. Another possibility is that readers have different subjective ideas of what constitutes an understandable lay-friendly text that reports scientific findings. This could have further implications on whether those readers benefit, for example by gaining knowledge, from PLS depending on their overall impression or subjective idea of a PLS. Our methodology does not allow us to make a judgement on this matter, but it would be an interesting topic for further research.

We also found ambivalent topics that were evaluated positively and negatively by different users. For example, some participants deemed the length of the PLSs appropriate, whereas others viewed them as too short or too long. One possible explanation concerns different underlying needs related to these topics on an interindividual level, for example due to different literacy levels (cf. also the literature on health literacy and health information, e. g. Nielsen-Bohlman/Panzer/Kindig 2004, Berkman/Davis/McCormack 2010). The present study does not allow any conclusions about whether certain groups of readers share the same needs with regard to PLSs. For example, it is possible that readers with higher literacy levels, such as practitioners or science communicators, may be more interested in a more differentiated text and benefit more from additional details than readers with lower literacy levels. Ideally, readers experience a congruence between their personal literacy level and situational factors, such as the literacy requirements posed by the reading material. This close match can lead to positive outcomes (e. g., knowledge gain), which bears resemblance to conclusions drawn by person-environment fit theory (e. g., Edwards et al. 2006). This theory describes that a fit between a person's values, needs or skills and situational factors such as environmental culture, supplies or requirements leads to positive outcomes (e. g., satisfaction, performance, or well-being) (Edwards et al. 2006).

To put these results into practice, we must consider how to improve the fit between readers' needs and the PLS requirements. We see several options for this: First, PLS-writers could aim to create a perfect fit between the PLSs and each individual's needs by writing individually tailored PLSs. Depending on the nature of the science communication offer, it may be appropriate to define the target audience, survey their common needs, and create PLSs that optimally match these needs. In the present case, the target group is broadly defined as the interested general population. Therefore, a second option may be expedient: to create a situation where a person can choose between options depending on their needs. For instance, additional information could be made accessible by hyperlink to provide on-demand information. Additionally, presenting the core information at the beginning of the PLS and additional details towards the end may allow users to stop reading when it becomes too demanding, without missing essential information.

Our findings in this exploratory study provide topics that might be worth investigating in future research such as: How do PLSs of psychological studies affect opinions on psychology as a discipline and the credibility of the summarized studies? Furthermore, the sweet spot of text length and the amount of information in relation to the different PLS-aims is a promising area of research, specifically in light of the needs of different target groups.

4.4.2 Conceptual framework

Our conceptual framework developed from a researcher's point of view (Stoll et al. 2022) helped us to structure user feedback on PLSs. It may thus not only be used for designing experimental studies on different PLS versions or for the development of PLS writing guidelines, but also for structuring and analyzing qualitative user data related to PLSs. In comparison to the models by Morville (2004) and Rosenbaum (2010), this framework is specifically geared towards PLSs, while Morville and Rosenbaum respectively provide models for user experience in general and user experience of evidence. While our framework is certainly limited in its application to PLSs, it is therefore also more suitable to identify and structure topics for this particular format type. PLSs (and other forms of lay-friendly summaries of published research) are becoming increasingly important in the scientific community, while there is presently still no clear consensus on quality standards. Therefore, we believe the specificity of the conceptual framework (Stoll et al. 2022) is needed for PLSs as a promising format of science communication.

How can we integrate the user perspective into this framework? We have found in this study that there are ambivalent topics for which the target group reports varying views. This is an issue that is not captured in the conceptual framework. Our conclusion is that the frame-

work is able to *identify* such topics, but not to *resolve* them. Solutions for the specific use case must be found in the practical implementation and in exchange with the users. We conclude that the theoretically developed conceptual framework covers all the topics mentioned by PLS users, and is suitable to identify subtopics that are relevant for PLS users.

4.4.3 Contribution and generalizability

The unique contribution of this study lies in the identification of user views on PLSs. Since we surveyed a large German general population sample, the views and topics outlined here might be a good reference point for the views of German laypeople interested in psychology. Taking this into account, future research questions can also be derived from the findings of this study. Additionally, this was the first time we exemplified possible applications of this conceptual framework by analyzing qualitative field data.

4.5 Conclusion

The first aim of this study was to explore the user perspective on German PLSs of psychological meta-analyses. The second aim was to check the overlap between topics named by participants and those suggested by the conceptual framework on PLSs by Stoll et al. (2022).

The results show a cornucopia of views on PLSs, which we were able to structure by using the conceptual framework. The framework showed to be comprehensive, but did not fully cover some more specific categories mentioned by the users. Also, some topics of the framework were only rarely or not at all mentioned by the participants. The topics we identified as frequently mentioned in this study give an indication for the central user concerns surrounding PLSs. They further can be used to derive future research questions. An important point is the fit between PLSs and target group, which can be addressed in two ways. PLSs can either be tailored to the specific needs of a target group, or PLSs can be presented so that users can select additional information on demand. We conclude that the conceptual framework is well suited to describe user feedback data and to identify potentials for further development of PLSs and PLS writing guidelines.

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Appendix

Table 1: Frequencies of positive feedback, suggestions for improvement, and additional feedback per subcategory

	positive feedback	suggestions for improve- ment	additional feedback
Specific Categories: PLS-aims			
Accessibility	156	158	24
Understandability: Understandability in General	157	63	4
Understandability: Understandability of the Scientific Method	2	3	4
Understandability: Understandability of the Results	3	10	0
Knowledge Acquisition	37	4	4
Empowerment: Empowerment in General	8	2	1
Empowerment: Personal Relevance	28	5	13
Communication of Research: Communication of Research in General	19	0	5
Communication of Research: Opinion about Psycho- logy	2	9	16
Communication of Research: Credibility of the Study	7	12	3
Improvement of Research	0	0	0
Specific Categories: PLS-characteristics			
Linguistic Attributes: General Linguistic Attributes	204	84	5
Linguistic Attributes: Comprehensibility of the Language	61	24	7
Linguistic Attributes: Use of Technical Terms	20	101	3
Linguistic Attributes: Use of Gender-neutral Language	1	11	7
Linguistic Attributes: Sentence Structure	5	1	2
Formal Attributes: General Formal Attributes	38	15	0
Formal Attributes: Text Length	167	87	6
Formal Attributes: Formal Display	54	12	3
Content: Content in General	129	59	19
Content: Amount of Information in the PLSs	100	52	5
Content: Interest in the Topic of the PLSs	174	5	40
Presentation of Results	22	80	4
Presentation of Quality of Evidence	4	4	1
Contextual Attributes	3	9	5
Unspecific Categories: in Favor of the PLSs	131	357	41
Unspecific Categories: to the Disadvantage of the PLSs	45	9	0