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A content analysis of referees' comments: how do comments on manuscripts rejected by a high-impact journal and later published in either a low- or high-impact journal differ?

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Abstract Using the data of a comprehensive evaluation study on the peer review process of *Angewandte Chemie International Edition* (AC-IE), we examined in this study the way in which referees' comments differ on manuscripts rejected at AC-IE and later published in either a low-impact journal (*Tetrahedron Letters*, $n = 54$) or a high-impact journal (*Journal of the American Chemical Society*, $n = 42$). For this purpose, a content analysis was performed of comments which led to the rejection of the manuscripts at AC-IE. For the content analysis, a classification scheme with thematic areas developed by Bornmann et al. (2008) was used. As the results of the analysis demonstrate, a large number of negative comments from referees in the areas "Relevance of contribution" and "Design/Conception" are clear signs that a manuscript rejected at AC-IE will not be published later in a high-impact journal. The number of negative statements in the areas "Writing/Presentation," "Discussion of results," "Method/Statistics," and "Reference to the literature and documentation," on the other hand, had no statistically significant influence on the probability that a rejected manuscript would later be published in a low- or high-impact journal. The results of this study have various implications for authors, journal editors and referees.

Keywords Journal peer review · Content analysis · Thematic areas for manuscript review · Fate of rejected manuscripts

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Introduction

Since journal peer review for scientific knowledge is so central to progress (Alberts et al. 2008), it is, according to Hames (2007), “essential that it is carried out well and professionally” (p. 2). For this, it is necessary that the peer review processes at the various scientific journals are investigated with regard to their quality (Bornmann and Daniel 2008b). In the opinion of Gosden (2003), peer review remains largely under-researched to date. LaFollette (1992) noted in particular the scarcity of research on such questions as how referees apply standards and the specific criteria established for making a decision on a manuscript (see here also Hemlin 1996; Shashok 2008). Electronic manuscript management systems, as they are meanwhile used by all important journals to perform their peer review process, provide a historical record of the documents which have undergone the peer review process. These documents form a superb corpus of data for empirical evaluation studies (see here Marchionini 2008).

Fifteen years after the study *Guardians of Science* (Daniel 1993/2004) (one of the most cited publications on peer review), we have once again received permission from Peter Göllitz, Editor-in-Chief, the Editorial Board, and the German Chemical Society (Gesellschaft Deutscher Chemiker, GDCh, Frankfurt am Main, Germany) to be able to perform a process evaluation of the manuscript refereeing at the journal *Angewandte Chemie International Edition* (AC-IE) (Bornmann and Daniel 2008a, b). AC-IE is one of the prime chemistry journals in the world, with a higher annual Journal Impact Factor (JIF, provided by Thomson Reuters, Philadelphia, PA, USA) than the JIFs of comparable journals (at 10.031 in the 2007 Journal Citation Reports, JCR, Science Edition). AC-IE is owned by the GDCh and published by Wiley-VCH (Weinheim, Germany). It introduced peer review in 1982, primarily in conjunction with one of the types of contributions published in the journal, “Communications,” which are short reports on work in progress or recently concluded experimental or theoretical investigations. What the editors of AC-IE look for most of all is excellence in chemical research. Manuscripts that referees (and editors) deem to be of high quality are selected for publication. Manuscripts that do not meet the high standards are rejected (Bornmann and Daniel 2009).

Available to us for the investigation are the reviews from the external referees, conducted on an evaluation form and comment sheet, for the manuscripts which were reviewed by AC-IE in 2000. In this study, we performed a content analysis of these reviews to determine referees’ criteria for the assessment of manuscripts and reasons for the referee’s recommendation to reject a manuscript for publication in AC-IE. The content analysis of the referees’ comments was thus performed for two manuscript groups: one group involved comments on 42 manuscripts rejected at AC-IE and later published, largely unchanged, in the *Journal of the American Chemical Society* (JACS). The JACS, the flagship journal of the American Chemical Society (Washington, DC, USA), is a periodical published weekly that is devoted to the publication of research papers (communications and full papers) in all fields of chemistry (both in the core areas and the interface of chemistry and biology, neurochemistry, materials, and single molecule chemistry). The other group is composed of referees’ comments on 54 rejected manuscripts which were later published, largely unchanged, in the journal *Tetrahedron Letters*. *Tetrahedron Letters* is an international journal for the rapid publication of all preliminary communications in organic chemistry. It is published weekly and covers developments in techniques, structures, methods and conclusions in

experimental and theoretical organic chemistry. JACS (JIF at 7.885 in the 2007 JCR) on the one hand represents a journal chosen for this study which has a reputation as high as that of AC-IE in the chemical community. *Tetrahedron Letters*, on the other hand, represents a journal included in this study which, with a JIF of 2.615 (2007 JCR), demonstrates a considerably lower impact than that of AC-IE and JACS.

For this study, why were referees' comments on manuscripts rejected at AC-IE and later published in one of these two journals chosen? A series of studies which examined the fate of manuscripts rejected by reputable journals (journals with a high JIF) showed that most of the papers were published later on in another journal (see Weller 2002, in the overview). As early as 1980, Abelson (1980) reported that almost all of the manuscripts rejected by *Science* were published later in other journals. "Papers are often being reviewed multiple times. Most of those rejected by *Science* go on to be considered at other journals" (Alberts et al. 2008). Of manuscripts rejected by *Angewandte Chemie* in the year 1984, Daniel (1993/2004) determined that 71% were later published elsewhere. In a current study on the fate of rejected manuscripts at the *Journal of Vascular and Interventional Radiology* (JVIR), it was determined that 213 of the 366 rejected JVIR submissions (58%) were subsequently published in 72 different journals (Silberzweig and Khorsandi 2008).

Altogether, the studies that examined the fate of rejected manuscripts are able to demonstrate, on the one hand, that negatively assessed manuscripts are generally not excluded from the formal scientific communication process, but are instead submitted again by the authors and published more or less unchanged elsewhere. On the other hand, the results of these studies demonstrate that there is a hierarchy of journal peer review quality standards: A manuscript that is rejected by one journal is accepted for publication by another journal. According to Judge et al. (2007) "perhaps the best signal of the quality of a paper is the journal in which it is published. The peer review system serves as a quality screen that is more rigorous at higher-quality journals, so that the best journals receive better papers to begin with and reject more of them than do low-impact journals" (p. 494). For Ziman (1968), "an article in a reputable journal does not merely represent the opinions of its author; it bears the *imprimatur* of scientific authenticity, as given to it by the editor and the referees he may have consulted" (p. 148).

In the context of the studies which dealt with the fate of rejected manuscripts, we would like to examine whether the differing fates of manuscripts rejected at AC-IE—a portion published after AC-IE rejection with *Tetrahedron Letters*, more a low-impact journal and another part with JACS, more a high-impact journal in the field of chemistry (comparable to AC-IE)—are also reflected in the comments of the external referees for the manuscripts. Do the referees refer in each case to differing thematic areas considered in manuscript assessment? For example, do the negative comments of the referees for the manuscripts later published in *Tetrahedron Letters* concern the quality of the research, such as technical flaws that undermine the work, and do the negative comments of the referees for the manuscripts later published in JACS concern rather "editorial matters" (e.g., writing style or written expression) (see here Adam and Knight 2002; Shashok 2008)? To answer these questions, a comprehensive content analysis was performed of the referees' comments which led to the rejection of manuscripts at AC-IE which were later published in *Tetrahedron Letters* or the JACS.

Methods

Manuscript reviewing at AC-IE

A manuscript submitted to AC-IE is usually subject to internal and external review. First, editors at the journal evaluate whether the manuscript contributes to the development of an important area of research (internal review). If the editors find that this is so, the submitted manuscript is sent to several independent referees (external review), who review it using a fully structured evaluation form together with a separate sheet for comments. The evaluation form contains a set of five questions and associated response categories: (1) "How important do you consider the results reported?" (Response scale: "Very important"; "Important"; "Less important"; "Unimportant"). (2) "Do the data obtained by experiment or calculation verify the hypotheses and conclusions?" (Response scale: "Yes"; "No"). (3) "Is the length of the manuscript appropriate to its contents?" (Response scale: "Yes"; "No, the manuscript is too long"; "No, the manuscript is too short"). (4) "Do you recommend acceptance of the Communication?" (Response scale: "Yes, without alterations"; "Yes, after minor alterations"; "Yes, but only after major alterations"; "No"). (5) "If you are of the opinion that the contribution is not suitable for publication in *Angewandte Chemie International Edition*, please indicate which other journal you consider more appropriate." On the separate comment sheet, the referees are to give their answers to the questions on the evaluation form as free text or they can indicate other relevant aspects for the decision of the AC-IE editors on a manuscript.

On the basis of the reviews of the external referees and on their own evaluations, the journal editors make the decision to accept or reject a manuscript for publication in AC-IE (Bornmann and Daniel 2009).

Database for the study

For the evaluation of the AC-IE peer reviews, information on a total of 1899 manuscripts that were reviewed in 2000 was used as database (Bornmann and Daniel 2008a, b). The information was taken from archive material which was recorded in the Wiley-VCH publishing house. In addition to internal assessment by the publisher, the 1899 manuscripts received a total of 4593 reviews on an evaluation form and/or comment sheet. Based on the reviews, 46% ($n = 878$) of the 1899 manuscripts were accepted for publication in AC-IE and 54% ($n = 1021$) were rejected. As demonstrated by research in the Web of Science (Thomson Reuters) and Chemical Abstracts (CA, Chemical Abstracts Services, CAS, Columbus, OH) literature databases, 959 (94%) of the 1021 rejected manuscripts were published more or less unchanged in another journal.

In the content analysis of the referees' comments of this study, a total of 223 reviews (evaluation forms and separate sheets for comments) were included which were prepared for (1) 42 manuscripts rejected by AC-IE and later published in JACS and (2) 54 manuscripts rejected by AC-IE and later published in *Tetrahedron Letters*. According to this, there are 2.3 reviews on average for each rejected manuscript. In the analysis, only those manuscripts were included for which there was only little difference in the manuscripts rejected at AC-IE and the manuscripts published later in the two other journals (see the supporting information by Bornmann and Daniel 2008a).

Thematic areas that were used for the content analysis of the referees' comments

Thematic analysis is the most common approach to content analysis. To prepare the thematic analysis of the referees' comments in this study, we conducted a content analysis of 46 research studies that examined editors' and referees' criteria for the assessment of manuscripts and their grounds for accepting or rejecting manuscripts. The results of this analysis are described in Bornmann et al. (2008). The goal of the analysis was to produce as complete a catalogue as possible of the different thematic areas examined by referees in manuscript assessment. A total of 572 criteria and reasons from the 46 studies could be assigned to nine areas: (1) "Relevance of contribution," (2) "Writing/Presentation," (3) "Design/Conception," (4) "Method/Statistics," (5) "Discussion of results," (6) "Reference to the literature and documentation," (7) "Theory," (8) "Author's reputation/Institutional affiliation," and (9) "Ethics." These nine areas, which are described in more detail below, were used in this study as a classification scheme for the content analysis of the AC-IE referees' comments.

1. "Relevance of contribution" groups together criteria and reasons that refer to the future "gain" that could result from publication of a manuscript. The possible "gain" relates to scientific advancement, relevance to journal readers, or practical usefulness of the findings. These aspects have to do mainly with the importance, newness, and originality of a study reported on in the manuscript. Table 1 lists, for example, some comments from the AC-IE reviews which were assigned to this or the other eight thematic areas.
2. "Writing/Presentation" groups together mainly criteria and reasons that refer to the formal quality of a manuscript, such as writing style, written expression, spelling, grammar, and professional appearance of the manuscript (see here Shashok 2008). Also in this area are criteria and reasons with regard to following the journal's publication guidelines and appropriate length of the manuscript. Thoroughness of the author also belongs here: Does the manuscript contain all of the necessary information in the different sections of the paper, written completely and comprehensibly?
3. Grouped under "Design/Conception" are criteria and reasons referring to correct and logical conceptual framework as well as to the adequacy of the research design. Further criteria and reasons here are the internal consistency of a study, the plausibility of the research design with regard to the research question, the quality of sampling, the generalizability of the results, and replicability.
4. The "Method/Statistics" area contains criteria and reasons that refer to the correctness, appropriateness, and newness of methods or statistical analyses. Also found here are criteria and reasons pertaining to the quality of operationalization of key constructs and to the measurement of data.
5. The criteria and reasons assigned to "Discussion of results" pertain mainly to whether the conclusions drawn in a manuscript are objective, correct, and properly based on the results. The criteria and reasons also address the existence and clarity of a "take-home message" in the manuscript or the breadth or depth of the discussion section.
6. The criteria and reasons under "Reference to the literature and documentation" have to do with whether the research study reported in the manuscript is embedded in the framework of the relevant literature. The criteria and reasons pertain to the up-to-date review of the literature cited and the thoroughness of the author's review of the literature.

Table 1 Examples of comments which a referee wrote for a manuscript submitted to AC-IE and which could be assigned in this study to one of the thematic areas considered in manuscript assessment

Area considered in manuscript assessment	Examples of referees' comments
Relevance of contribution	"A stunning paper with outstanding results ...", "... very important and challenging topic ...", "... very nice result that fills the gap in the knowledge of ...", "... interesting example of a unique asymmetric catalyst ...", "... an important and exciting work ...", "... new synthetic success ...", "... the paper is certainly of significance to chemists ...", "This is a very important step forward in the search of ...", "This manuscript will make an important impact to chemistry", "... a general audience should be interested in their findings"
Writing/Presentation	"... the material is well organized ...", "The article is rather difficult to read ...", "... well documented results ...", "... the length of the paper should be reduced", "... the length and the writing style is appropriate for the content of the manuscript", "The manuscript is technically sound ...", "... a story which is described in a tedious, cumbersome manner", "The manuscript is well written and the data are nicely presented ...", "There is a lack of state of the art presentation of ..."
Design/Conception	"... no rational design behind the ...", "... the most elementary control experiments are missing", "... the author's claim that ... is questionable"
Method/Statistics	"... the kinetic data is badly undermined by the author's blind application of ...", "... only one spectrum of the laser flash experiment can not give solid evidence for ...", "Detailed NMR analysis using various techniques are required to support the calculated conformations", "... an experimental illustration has not been given"
Discussion of results	"... no explanation is given for ...", "... is not discussed at all ...", "... not even an attempt has been made to explain this ...", "... the authors do not propose any explanation for the interesting effect they observed", "... the interpretation remains very qualitative", "... this affirmation is highly speculative", "The authors state in their concluding remarks that ... but they fail to present evidence for this", "The authors should pay more attention to the use of significant figures", "... does not seem to justify the conclusion that ...", "The intention of the authors to demonstrate the utility of ... has been at most partially verified"
Reference to the literature and documentation	"The referencing is somewhat unbalanced", "... is already described in the literature ...", "... there is a plethora of work carried out by several groups ... none of the papers is cited in this manuscript", "... an approach which has already been reported by ... <i>et al.</i> Surprisingly, there is no reference of the UCLA-group at all", "... not a single leading person in enolate oxidation chemistry is quoted"
Theory	"I find some other statements in the paper very difficult to believe ...", "Also one does not need to postulate an insertion into C-X first and then radical formation ..."
Author's reputation/ Institutional affiliation	"This is another interesting report from the ... group", "I regard the authors as absolute top organic chemists ...", "The authors have previously published a series of nice papers ..."
Ethics	"... the authors neglect the advance of others in the field", "... the reaction has already been published by ...", "... this is an extension of the work reported by the authors before ...", "However the main facts have been reported recently in ...", "This paper is essentially identical to the paper of 1998"

7. The criteria and reasons under “Theory” are concerned with whether the manuscript contributes to theory development or whether the theory underlying the research study seems complete and sound.
8. Whereas the areas presented above pertain to the content of manuscripts and the research on which manuscripts report, there are also criteria and reasons that refer to the “reputation or institutional affiliation of the authors.” The criteria and reasons here address the scholarship demonstrated in the manuscript and the reputation of the authors in their research areas (see here also Kupfersmid 1988).
9. The area “Ethics” captures criteria and reasons that pertain to the compatibility of a manuscript (or the compatibility of the research behind a manuscript) with scientific or disciplinary ethics.

Performing the content analysis

The content analysis of the referees' comments was performed by a total of four people from our research team with the aid of the nine thematic areas in this study. The second author of this paper, with a doctorate in chemistry, was in charge in this case. First, three people, independently of each other, assigned the referees' comments to the areas. According to Gosden's (2003) method, the unit of analysis here was generally a complete sentence, although one definable comment may spread over more than one sentence. Table 1 gives examples of comments which a referee wrote for a manuscript and which were able to be assigned in this study to one of the areas considered in manuscript assessment. Assigning the referees' comments to the areas by three people was checked by the fourth person on our research team for disparities. All assignments for which this person had determined disparities were discussed within the team, and the team found a mutual solution for these assignments.

Along with assigning the referees' comments to the areas, the four people also conducted an evaluation as to whether a comment judged the content of a manuscript to be positive or negative. Did a referee criticize the content or did he/she commend it? In a part of the reviews, it was also found that a referee gave positive and negative comments in a review which could be assigned to the very same area. Table 2 shows an excerpt from the worksheet in which the positive and negative comments assigned to an area (here: “Relevance of contribution” and “Writing/Presentation”) were recorded by our research team. Positive comments were coded with a 1 and negative comments were coded with a -1. A line in the table contains the code numbers assigned to a review. The columns represent the code assignments within a review to the various thematic areas.

Logistic regression analysis

To identify the relationship between the areas considered in AC-IE manuscript assessment and the later publication of a manuscript in a low- or high-impact journal, we used multiple logistic regression models (Hosmer and Lemeshow 2000). These models are appropriate for the analysis of dichotomous (or binary) responses. Dichotomous responses arise when the outcome is the presence or absence of an event (Rabe-Hesketh and Everitt 2004). In this study, the binary response is coded 0 for the later publication of a rejected manuscript in a low-impact journal (*Tetrahedron Letters*) and 1 for the later publication of a rejected manuscript in a high-impact journal (JACS). In the model, the thematic areas considered in

Table 2 Excerpt from the worksheet on which the positive (1) and negative (−1) comments assigned to an area (here: “Relevance of contribution” and “Writing/Presentation”) in this study were entered

Manuscript no.	Review no.	Relevance of contribution			Writing/Presentation	
		First comment regarding this area	Second comment regarding this area	Third comment regarding this area	First comment regarding this area	Second comment regarding this area
1	1	−1	1		1	−1
	2	1	−1	1	1	−1
	3	1	−1		−1	−1
2	1	−1	−1	−1	1	−1
	2	−1			−1	−1

manuscript assessment form the independent variables and the dichotomous responses (low- or high-impact journal) form the dependent variable.

The violation of the assumption of independent observations caused by including more than one review for one single manuscript (see above) is considered in the logistic regression models by using the “cluster” option in Stata (StataCorp 2007). This option specifies that the reviews are independent across the manuscripts, but are not necessarily independent within one and the same manuscript (Hosmer and Lemeshow 2000, Sect. 8.3).

We used the Hosmer–Lemeshow (HL) test statistic to proof the fit of the binary regression models (Hosmer and Lemeshow 2000). The idea of the HL test statistic is to compare predicted probabilities as an outcome of the model estimation with the observed data (the input for the estimation) (Long and Freese 2006). The HL statistic calculated for the models in this study suggested that the models do fit well.

Results

Assigning comments to the various thematic areas

Table 3 indicates the number of referees’ comments which could be assigned to the nine areas considered in AC-IE manuscript assessment. As shown in the columns under the heading “Positive and negative comments” in the table, a total of 1285 comments in the 223 reviews were assigned to an area (on average 5.76 comments per review). The majority of the comments ($n = 1113$, on average 4.99 comments per review) dealt critically with the content of a manuscript: only 172 comments refer favorably to a manuscript (on average 0.77 positive comments per review). Since all manuscripts which were included in this study were rejected by the editors for publication in AC-IE, this result is hardly surprising. However, the results of Bakanic et al. (1989) for the journal *American Sociological Review* also demonstrate that negative comments do not dominate only in the case of rejected manuscripts: “When addressing the authors of eventually published manuscripts, referees were more likely to preface the inevitable criticisms with positive comments. The ratio of negative to positive comments to the author was approximately 4:1 for accepted manuscripts and 5:1 for rejected manuscripts. This made interpreting the referees’ comments more difficult for authors, since comments accompanying favorable

Table 3 Comments from the referees assigned to the areas considered in the assessment of the manuscripts rejected by AC-IE and later published in a low- or high-impact journal (223 reviews for 96 manuscripts) (arranged according to the sum of positive and negative comments over all reviews, see the right-hand column)

Areas considered in manuscript assessment	Positive comments ^a			Negative comments ^a			Positive and negative comments		
	Minimal/maximal number in a review	Average number per review	Sum over all reviews	Minimal/maximal number in a review	Average number per review	Sum over all reviews	Minimal/maximal number in a review	Average number per review	Sum over all reviews
Relevance of contribution	0/3	0.54	120	0/5	1.54	343	0/7	2.08	463
Writing/Presentation	0/2	0.10	22	0/17	1.85	413	0/17	1.95	435
Discussion of results	0/2	0.04	9	0/4	0.76	169	0/5	0.80	178
Method/Statistics	0/1	0.05	10	0/3	0.33	73	0/3	0.37	83
Design/Conception	0/1	0.03	6	0/3	0.26	57	0/3	0.28	63
Reference to the literature and documentation	0/1	0.01	3	0/4	0.22	49	0/4	0.23	52
Ethics	0/0	0.00	0	0/2	0.03	6	0/2	0.03	6
Author's reputation/Institutional affiliation	0/1	0.01	2	0/1	0.01	1	0/1	0.01	3
Theory	0/0	0.00	0	0/1	0.01	2	0/1	0.01	2
Total	0/6	0.77	172	0/21	4.99	1113	0/22	5.76	1285

^a For positive comments, a referee positively assessed an aspect which could be assigned in the content analysis to an area (e.g. "Relevance of contribution"); negative comments relate to the critical assessment of an aspect by a referee. The column under the heading "positive and negative comments" indicates the number of *all* comments in the reviews, i.e. no distinction is made between a comment that is worded positively or negatively

recommendations were as critical as those with a recommendation to reject” (p. 643, see her also Campanario 1998).

Most of the comments from the AC-IE referees ($n = 463$, positive *and* negative comments) could be assigned to the area “Relevance of contribution” as shown in Table 3. In addition, by way of comparison, many comments could be assigned to the areas “Writing/Presentation” ($n = 435$) and “Discussion of results” ($n = 178$). In view of the AC-IE peer review process, it may also be that the questions on the evaluation form for referees relate to these areas in particular and the referees note their answers to these questions on the comment sheet. The question “How important do you consider the results reported?” and the sentence “If you are of the opinion that the contribution is not suitable for publication in *Angewandte Chemie International Edition*, please indicate which other journal you consider more appropriate” relate to the relevance of a contribution (for the journal). The question “Do the data obtained by experiment or calculation verify the hypotheses and conclusions?” relates to an appropriate discussion of the results by the author of a study. The question “Is the length of the manuscript appropriate to its contents?” addresses one of those aspects which was assigned to the area “Writing/Presentation” in this study.

The areas “Relevance of contribution” and “Writing/Presentation” appear, however, to play an important role not only in the AC-IE peer review, but also in other peer review processes. In the content analysis of 46 research studies (Bornmann et al. 2008) that examined editors’ and referees’ criteria for the assessment of manuscripts and their grounds for accepting or rejecting manuscripts, most criteria and reasons could be assigned to these two areas. Dickersin et al. (2007) “performed an observational study of discussions at manuscript meetings at *JAMA*, a major US general medical journal ... Phrases related to science predominated (1274 or 54%). The editors, most of whom were physicians, also placed major weight on goals important to *JAMA*’s mission (journalism goals) such as importance to medicine, strategic emphasis for the journal, interest to the readership, and results (729 or 31% of phrases). About 16% ($n = 373$) of the phrases used related to writing issues, such as clarity and responses to the referees’ comments.”

The results of the logistic regression analyses

Two binary regression models have been calculated with the number of positive and negative or only negative comments in a review which was written for a manuscript rejected at AC-IE. The models are to determine the areas of assessment that can be definitively associated with the later publication of a rejected manuscript in a low- or high-impact journal. In the regression models, six of the total of nine thematic areas could be considered. The three areas “Ethics,” “Author’s reputation/institutional affiliation” and “Theory” were not included, since for these areas, the number of the assigned referees’ comments in total was too low (see the figures in Table 3).

As shown in Table 4, the one model (model A) uses the number of positive *and* negative comments and the other model (model B) uses the number of *only* negative comments. No model with the number of *only* positive comments was calculated, since in general, only a few positive comments can be found in the reviews (see the figures in Table 3). Proportionate to the dominance of the negative comments in the reviews, Table 4 shows that there are very similar results for both regression models A and B: In both models, a statistically significant effect of the thematic areas “Relevance of contribution” and “Design/Conception” is demonstrated. On the other hand, of the other areas, no statistically significant effects are shown.

Table 4 Binary regression models predicting publication in a high-impact journal (low-impact journal = 0, high-impact journal = 1) of a manuscript rejected at AC-IE. Model A is based on the number of positive *and* negative comments in a review of a thematic area considered by the referee in manuscript assessment; model B only applies to the number of *negative* referee comments on an area

Thematic area considered in manuscript assessment	Model A: positive and negative comments	Model B: only negative comments
Relevance of contribution	-0.411*** (-4.18)	-0.337*** (-3.65)
Writing/Presentation	-0.0669 (-1.02)	-0.0665 (-1.01)
Discussion of results	0.118 (0.69)	0.0463 (0.27)
Method/Statistics	0.0861 (0.32)	0.123 (0.43)
Design/Conception	-0.632** (-2.70)	-0.539* (-2.21)
Reference to the literature and documentation	-0.234 (-1.04)	-0.198 (-0.85)
Intercept	0.935* (2.46)	0.609 (1.79)
n_{reviews}	223	223
$n_{\text{manuscripts}}$	96	96

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Standard errors are adjusted for the dependency in the data set, that for a manuscript rejected at AC-IE and published in a low- or high impact journal, there are on average 2.3 reviews

To exemplify the influence of both of the areas “Relevance of contribution” and “Design/Conception” considered in manuscript assessment for the publication of a rejected manuscript in a low- or high-impact journal, predicted probabilities have been subsequently computed on the regression analyses (Long and Freese 2006). The results of these calculations are shown in Fig. 1. In this figure, for each area, there are two charts (corresponding to the models A and B): one chart relates to positive *and* negative comments (charts A and B) and one chart *only* relates to negative comments (charts C and D). In each chart, the probability of a manuscript of being published in a high-impact journal is shown on the y-axis; on the x-axis the number of (positive and) negative referees' comments is plotted. It can be clearly seen in all charts that with an increasing number of comments, the probability of being published later in a high-impact journal considerably decreases (whereas all other independent variables were kept constant at their mean). A large number of (negative) comments from the referees in both of the areas “Relevance of contribution” and “Design/Conception” is thus—independent of the number of (negative) comments in the other areas—a clear sign that a manuscript rejected at AC-IE will not be published later in a high-impact journal.

Discussion

In this study, using the data of a comprehensive evaluation study on the peer review process of AC-IE, we examined the way in which referees' comments on manuscripts rejected at AC-IE and later published in either a low-impact journal (*Tetrahedron Letters*) or in a high-impact journal (JACS) differ. For this purpose, a content analysis of the comments that led to the rejection of the manuscript at AC-IE was performed. For the content analysis of the comments, a classification scheme with thematic areas developed by Bornmann et al. (2008) was used. As the results of the analysis show, the probability for

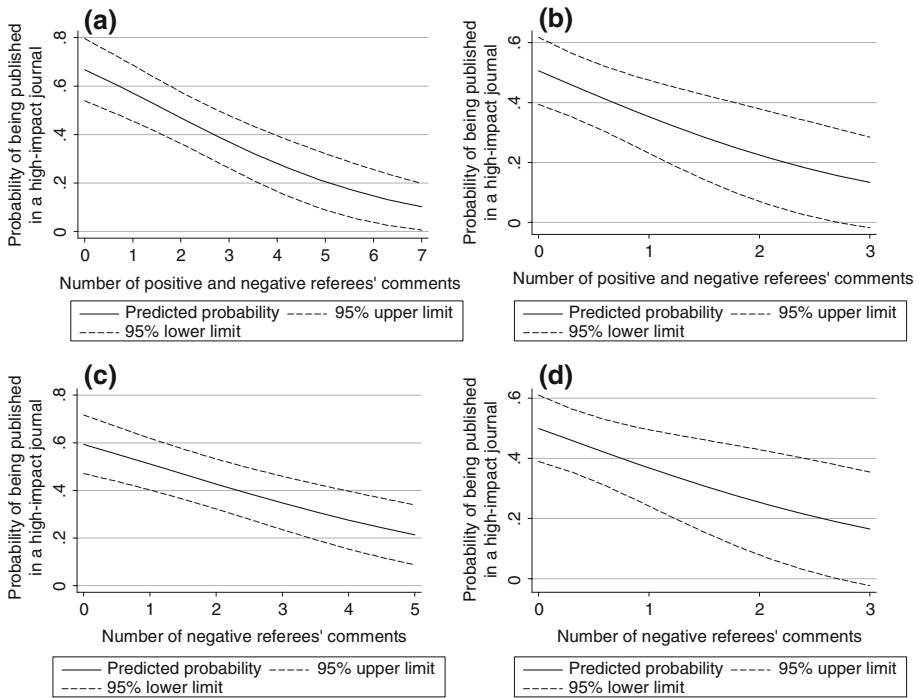


Fig. 1 Predicted probabilities (with 95% confidence interval) for a manuscript rejected at AC-IE to be published later in a high-impact journal, depending on the number of positive and negative (charts **a** and **b**) or only negative comments (charts **c** and **d**) in a review of the areas considered in AC-IE manuscript assessment: “Relevance of contribution” (charts **a** and **c**) and “Design/Conception” (charts **b** and **d**). *Notes:* Example reading of graph C. With an increasing number of negative comments in the area “Relevance of contribution,” the probability of being published later in a high-impact journal considerably decreases (whereas all other independent variables were kept constant at their mean)

the publication of a rejected manuscript in a high-impact journal is thus greatest when the areas “Relevance of contribution” (for the journal, scientific advancement, etc.) and “Design/Conception” (of the study) scarcely have negative comments in the reviews. On the other hand, the number of negative comments in the areas “Writing/Presentation”, “Discussion of results”, “Method/Statistics”, and “Reference to the literature and documentation” does not have any statistically significant influence on the probability that a rejected manuscript is later published in a low- or high-impact journal.

Turcotte et al. (2004) were already able to determine for the peer review of the *Canadian Journal of Anesthesia* that just the two areas “Relevance of contribution” and “Design/Conception” considered in manuscript assessment are decisive for the fate of a manuscript: “Comment analysis suggests that the relationship between the experimental design, the results, and the conclusion was the main determinant of an article’s fate. Lack of originality [in this study an aspect considered in the area “Relevance of contribution”] or inappropriate experimental design were likely to be associated with rejection. Conversely, aspects involving the presentation of manuscripts (tables, figures, references) were rarely cited as reasons to justify acceptance or rejection” (p. 549, see also Abelson 1990; Sternberg et al. 1997).

The results of this study have various implications for authors, journal editors and referees (in the field of chemistry): The question for *authors*, following the rejection of their manuscript by a journal, is generally to which other journal the manuscript should be resubmitted. In the context of the results of this study, an author should then choose a journal for the resubmission with a similarly high reputation as that of the rejecting journal, if the criticism in the reviews does *not* relate to the relevance of the contribution, and the design/conception of the study is not fundamentally criticized, but rather if the criticism primarily relates to other areas. For a manuscript for which the referees hardly criticized the relevance and the design/conception of a contribution, *journal editors* should instead consider a revision by the authors and a reassessment than a rejection decision. Correspondingly, *referees*, if their criticism of the contents of a manuscript that they have to assess hardly relates to the relevance and the design/conception of a study (instead other areas), should recommend to the editor a revision rather than a rejection of the manuscript. For the *readers* of scientific papers, the results of this study indicate that in a high-impact journal, rather than in a low-impact journal, they can expect manuscripts that have a high relevance (for scientific advancement) in a specialty field and meet certain (high) quality standards in terms of design/conception of a study.

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