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*Published in:*
Learning and Individual Differences

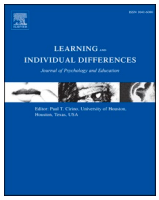
*DOI:*
10.1016/j.lindif.2022.102175

Learning and Individual Differences 97 (2022) 102175

Contents lists available at ScienceDirect

Learning and Individual Differences

journal homepage: www.elsevier.com/locate/lindif



# What influences students' peer-feedback uptake? Relations between error tolerance, feedback tolerance, writing self-efficacy, perceived language skills and peer-feedback processing☆

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ARTICLE INFO

*Keywords:*
Peer-feedback uptake
Error tolerance
Feedback tolerance
Perceived language skills

ABSTRACT

This study investigated the extent to which the uptake of peer-feedback of 10th grade students ($N = 160$, age range = 15–16) related to intrapersonal factors (error tolerance, feedback tolerance, and writing self-efficacy) and interpersonal factors (feedback provider's language skills, as perceived by the feedback recipient). Two groups of students received similar feedback on their writing performance, provided by trained research-assistants. Half the students was led to believe that feedback was provided by a peer perceived to have stronger language skills than their own, whereas the other half was led to believe that feedback was provided by a peer perceived to have weaker language skills than their own. Results showed that (1) error tolerance was related to feedback tolerance, (2) perceived language skills of the feedback provider positively related to the uptake of peer-feedback on writing style, and (3) error tolerance, feedback tolerance, and writing self-efficacy did not relate to peer-feedback uptake. These results emphasize the central role of errors in peer-feedback processing and they imply that the importance of interpersonal factors should not be overlooked when predicting or explaining peer-feedback uptake.

## 1. Introduction

Nowadays, peer-feedback is frequently used to improve writing skills in various educational contexts. Several studies indeed provided evidence for improved writing performance as a result of the processing of peer-feedback, i.e. the procedure of thinking about and potentially acting upon feedback received from peers (Gielen et al., 2010; Huisman et al., 2018; Huisman et al., 2019; Latifi, Noroozi, Hatami, & Biemans, 2021; Latifi, Noroozi, & Talaee, 2021). Simultaneously, predicting outcomes of peer-feedback processing is complex, as effects of peer-feedback highly depend on contextual factors (e.g., Ciftci & Kocoglu, 2012; Gielen et al., 2010; Nelson & Schunn, 2009; Wihastyanang et al., 2020; Zhang & McEneaney, 2020). Recent literature has emphasized the concurrent impact of intrapersonal and interpersonal factors as fundamental contextual factors for explaining feedback processing behavior and potential performance improvement in educational contexts (Aben et al., 2019; Esterhazy & Damşa, 2019).

With respect to intrapersonal factors—i.e., personal characteristics—, one's tolerance towards errors (e.g., Rybowiak et al., 1999), and tolerance towards feedback (e.g., King et al., 2009), may be central in the processing of peer-feedback and its subsequent impact on writing performance. Students who process peer-feedback are likely to be confronted with (a) performance elements perceived as erroneous or improvable by the feedback provider, and (b) feedback elements identifying and criticizing these performance elements. Therefore, this study aims to investigate the extent to which students' tolerance to deal with errors and with peer-feedback affects their peer-feedback uptake. In the context of this study, peer-feedback uptake refers to textual revisions performed by students (Carless & Boud, 2018; Wichmann et al., 2018). In order to reach the aim of this study, first a better understanding of the

☆ This work was supported by the Department of Educational Sciences, University of Groningen.

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https://doi.org/10.1016/j.lindif.2022.102175
Received 7 September 2021; Received in revised form 8 June 2022; Accepted 14 June 2022
Available online 29 June 2022

components underlying those tolerance constructs is required. Previous research suggested that several components of error and feedback tolerance (cognitive, emotional, and meta-cognitive) could theoretically be distinguished, and may also affect feedback processing differently (King et al., 2009; Rybowiak et al., 1999). Furthermore, ample research on peer-feedback underscores that writing self-efficacy is another important intrapersonal factor in the domain of writing (e.g., Ekholm et al., 2015; Ruegg, 2018; Zheng et al., 2018).

In terms of interpersonal factors—i.e., perceptions of the other—, students' peer-feedback uptake may be affected by perceptions of their peers' language skills (e.g., Berndt et al., 2018; Strijbos et al., 2010). Whereas perceived expertise is a factor known to potentially affect feedback processing in general (e.g., Panadero, 2016; Winstone et al., 2017), the effects appear to predominate in the context of peer-feedback processing (e.g., Alqassab et al., 2018a; Berndt et al., 2018; Strijbos et al., 2010); presumably because students may be more likely to doubt the expertise of a peer (horizontal constellation), than, for example, a teacher (vertical constellation) (Strijbos & Müller, 2014).

Hence, intrapersonal as well as interpersonal factors play a non-ignorable role in peer-feedback processing. Consequently, insights in how these factors affect peer-feedback uptake can contribute to a more complete understanding of peer-feedback processing, and outcomes of peer-feedback activities. Therefore, the overall aim of this research is to simultaneously study the potential associations of intrapersonal and interpersonal factors on peer-feedback processing behavior, particularly focusing on (1) error tolerance, (2) feedback tolerance, (3) writing self-efficacy, and (4) perceived language skills. Knowledge about associations between these intrapersonal and interpersonal factors and peer-feedback processing is especially important as awareness of such associations may contribute to optimizing the learning gains of peer-feedback processing.

## 2. Theoretical foundation

### 2.1. Intrapersonal factors and feedback processing

#### 2.1.1. Error tolerance

Errors are often defined as deviations from a norm (e.g., Gloy, 1987; Oser & Spychiger, 2005; Rach et al., 2012). A consequence of defining errors in this way is that the notion of 'error' becomes subjective, because the notion of 'norm' is ambiguous. Norms may refer to implicit, personal codes of conduct (e.g., situation-specific behavioral expectations), generalized written rules (e.g., grammar prescriptions in a specific language), the minimum performance for a passing grade (e.g., examinations), or anything in between. Consequently, people may have different opinions regarding the extent to which a performance deviates from norms and the extent to which (parts of) a performance is erroneous. As such, the same performance may be perceived as erroneous, based on internal standards and internal feedback, but may also be perceived as non-, or less-erroneous, when compared to external representations of standards or reference values; or vice versa (Narciss, 2013).

Because of the subjectivity of errors, the importance of one's resilience towards the experience of having performed in a way that is perceived as deviating from the norm, i.e., one's error tolerance, has increasingly received scholarly attention. The role of tolerance towards errors is viewed as an indispensable part of the learning process (Kapur, 2016; Metcalfe, 2017; Rach et al., 2012). Especially in the context of peer-feedback, students' error tolerance can be put to the test, because students may relatively easily doubt the feedback provider's abilities to correctly identify and respond to errors—often subsumed in the broader construct of trust (in the assessor) (Panadero, 2016; Van Gennip et al., 2009, 2010).

Given the potential importance of error tolerance for peer-feedback processing, it is relevant to investigate whether underlying components of error tolerance may affect peer-feedback processing in different ways. This requires the theoretical and empirical examination of those components. The literature distinguishes two components, namely, the emotional and cognitive aspects of error tolerance. First, one's emotional error tolerance refers to the extent to which errors evoke affective responses. Learners with a low emotional error tolerance are afraid of making mistakes, become strained by making errors, and fear the occurrence of errors (called 'error strain' by Rybowiak et al., 1999). Second, one's cognitive error tolerance entails the extent to which one perceives errors as important for learning. Learners with a high cognitive error tolerance view it as important to prevent errors in the long term by continuously improving, adapting, or developing performance and approaches (called 'learning from errors' by Rybowiak et al., 1999). In addition, we propose a meta-cognitive component of error tolerance, that can be defined as the extent to which one takes the time to think about errors. Learners with a high meta-cognitive error tolerance thoroughly analyze errors and the way errors could have been prevented. The existence of such a component, next to an emotional and cognitive component, is conceivable, as previous research suggests that thinking about errors may help to remember the context in which the error was made, which may contribute to error avoidance in the future (Metcalfe, 2017; Wahlheim & Jacoby, 2013).

#### 2.1.2. Feedback tolerance

Feedback tolerance can be defined as the learners' resilience towards performance-relevant information provided to promote their learning. Learners with a high feedback tolerance recognize, process, and internalize feedback easily, and are open to receiving feedback (Smith & King, 2004). King et al. (2009) emphasize that intrapersonal factors such as feedback tolerance are highly relevant for explaining and predicting responses to feedback. For example, individuals with a low feedback tolerance may develop negative attributions due to error-oriented feedback, and may, as a result, be less likely to take action upon the feedback (Smith & King, 2004).

Because of the central role of errors in learning and feedback, the three hypothesized components of error tolerance may have corresponding counterparts in feedback tolerance. First, one's emotional feedback tolerance refers to the extent to which feedback evokes affective responses. Learners with a low emotional feedback tolerance are afraid of feedback, become strained by receiving criticism, and fear the occurrence of corrections (called 'sensitivity' by King et al., 2009; see also Edwards & Pledger, 1990). Second, one's cognitive feedback tolerance entails the extent to which one perceives feedback as important for learning. Learners with a high cognitive feedback tolerance perceive feedback as important for improving their future performance by continuously improving, adapting, or developing performance and approaches (called 'utility' by King et al., 2009; see also Edwards & Pledger, 1990). Third, meta-cognitive feedback tolerance can be defined as the extent to which one takes the time to think about feedback. Learners with a high meta-cognitive feedback tolerance thoroughly analyze feedback and the way the reception of feedback could have been prevented. The existence of such a meta-cognitive component is conceivable, as ample research has emphasized that feedback can be provided on students' self-regulation (Alqassab et al., 2018b; Gan & Hattie, 2014; Hattie & Timperley, 2007), which implies processing of feedback at a meta-cognitive level, and, thus, underlines the potential relevance of meta-cognitive feedback tolerance.

#### 2.1.3. Writing self-efficacy

A feedback recipient's domain-specific self-efficacy has been shown to play a role in feedback processing (Duijnhouwer et al., 2012; Kluger & DeNisi, 1996; Shute, 2008; Winstone et al., 2017). In general terms, Zimmerman and Bandura (1994) showed that perceived academic self-efficacy had a positive effect on personal goal setting, implying a higher motivation to perform well. More specifically, Wingate (2010) argues that students with a high self-efficacy are more likely to act upon feedback than students with a low self-efficacy, because they are more

willing to achieve skill improvement. In the domain of writing, this line of reasoning would imply that students who perceive their own language skills as strong are more likely to take-up peer-feedback than students who perceive themselves to have weak language skills.

### 2.2. Interpersonal factors and peer-feedback processing

Recently, the importance of interpersonal factors describing the relationship between feedback providers and recipients has been emphasized for explaining feedback processing in educational settings (Aben et al., 2019; Esterhazy & Damşa, 2019). Students who process peer-feedback are also members of social constellations, such as classrooms. Hence, they are likely to attend group discussions, to collaborate with peers on learning tasks, and they could be aware of their peers' skills or grades. These pieces of information about peers may, either consciously or unconsciously, contribute to the composition of a mental representation of their peers' expertise—as well as their own expertise in comparison to their peers' expertise— and can, thus, potentially affect feedback processing (Aben et al., 2019; Strijbos & Müller, 2014; Winstone et al., 2017).

The comparison between the perceived expertise of the feedback provider and one's own expertise may be particularly influential in the peer-feedback processing of adolescents, as adolescents are highly susceptible to the opinions and perceptions of peers (Sebastian et al., 2008; Van der Aar et al., 2018). Students who process peer-feedback are confronted with criticism provided by fellow students with more or less similar educational experiences (e.g., being in the same track and/or classroom) through which they develop a sense of which students are better or worse in a certain subject, task or skill. This in turn may affect their perception of the fellow student, and the degree to which their perception of a particular students' expertise convinces them to view the feedback issued by that particular student as potentially worthwhile (Panadero, 2016; Van Gennip et al., 2009, 2010). For example, Strijbos et al. (2010) and Berndt et al. (2018) found that feedback provided by a peer with low competence was perceived as less adequate than feedback provided by a highly competent peer.

### 2.3. Peer-feedback processing behavior in the domain of writing

Effects of intrapersonal and interpersonal factors on peer-feedback processing are primarily visible in recipients' feedback perceptions and choices to (partly) take-up peer-feedback, i.e., to revise their performance. Text revisions based on peer-feedback on writing are typically split into local revisions and global revisions (e.g., Lam, 2010; Saeed et al., 2018; Yang, 2016). Local revisions relate to a text's surface characteristics and associated lower order concerns, such as interpunction, spelling, and grammar. Most lower order issues are characterized by the fact that they can be either correct or incorrect: the correctness of interpunction, spelling, and grammar can be checked in handbooks with prescriptions (Cho & MacArthur, 2010). Global revisions relate to the meaning of a text and associated higher order concerns, such as the line of reasoning, text structure, and argumentation (e.g., Winder et al., 2016).

Whereas the terminology of 'local revisions' and 'global revisions' is generally used in a mutually exclusive manner, Kavadlo (2005) argues that revisions related to 'writing style' can be local as well as global. For example, whereas providing support for a claim is, according to Kavadlo (2005), often perceived as a higher order concern, and unnecessary repeating information as a lower order concern, the latter may be the result of a lack of the former. Consequently, revisions aiming to improve writing style may be related to both local and global issues. In this study, we defined feedback on writing style as non-meaning-changing alternatives for sentences without punctuation, spelling, or grammar errors. In this way, writing style was separated from lower order concerns (i.e., punctuation, spelling and grammar) and from higher order concerns (i.e., meaning changing text elements). Therefore, we decided to measure effects on peer-feedback uptake in terms of revisions related to (1) lower order concerns, (2) writing style, and (3) higher order concerns.

### 2.4. The present study

The present study is part of a diptych, in which the same sample of students provided peer-feedback and processed peer-feedback. The results of the first part of the diptych indicated that peer-feedback provision was hardly affected by the perceived language skills, whereas the provided peer-grades were affected by the perceived language skills. The present study contributes to these findings, as the present study focused on the peer-feedback processing behavior. The aim was to investigate associations of both intrapersonal factors (i.e., emotional, cognitive, and meta-cognitive error tolerance; emotional, cognitive, and meta-cognitive feedback tolerance; and writing self-efficacy,) and interpersonal factors (i.e., perceived language skills) with the uptake of peer-feedback on an argumentative text as part of the curriculum in the school subject 'Dutch'.

Additionally, we investigated the extent to which the relations between error tolerance and peer-feedback uptake are mediated by feedback tolerance, as one's tolerance towards errors is likely to be a precursor of one's tolerance towards feedback. That is, as a result of the error- and improvement-oriented nature of feedback, the processing of feedback is inherently connected to the confrontation with errors and potential tolerance towards errors. As such, we expect that the extent to which individuals are tolerant towards errors, predicts the extent to which they are tolerant towards feedback, and consequently the extent to which they take-up feedback (see Fig. 1). This resulted in five research questions and associated hypotheses:

**H1**. To what extent can emotional, cognitive, and meta-cognitive components of error tolerance and feedback tolerance be distinguished among 10th grade students?

As the constructs of error tolerance and feedback tolerance can theoretically be conceived as consisting of multiple components, it was hypothesized that an emotional, cognitive, and meta-cognitive component for both error tolerance and feedback tolerance could be adequately measured and distinguished statistically (H1).

**H2**. To what extent do emotional, cognitive, and meta-cognitive components of error tolerance among 10th grade students relate to the proportion of text revisions in line with peer-feedback on argumentative texts?

It was hypothesized that emotional (H2a), cognitive (H2b), and meta-cognitive (H2c) error tolerance positively related to the proportion of text revisions in line with peer-feedback.

**H3**. To what extent are the relations between emotional, cognitive, and meta-cognitive components of error tolerance and the proportion of text revisions in line with peer-feedback mediated by, respectively, emotional, cognitive, and meta-cognitive components of feedback tolerance?

It was hypothesized that emotional (H3a), cognitive (H3b), and meta-cognitive (H3c) components of feedback tolerance significantly mediated the relations between, respectively, emotional, cognitive, and meta-cognitive components of error tolerance and the proportion of text revisions in line with peer-feedback.

**H4**. . To what extent does 10th grade students' writing self-efficacy relate to the proportion of text revisions in line with peer-feedback on argumentative texts?

It was hypothesized that the higher student's writing self-efficacy would be, the more text revisions would be in line with peer-feedback (H4).

**H5**. . To what extent do 10th grade students' perceptions of their peers'

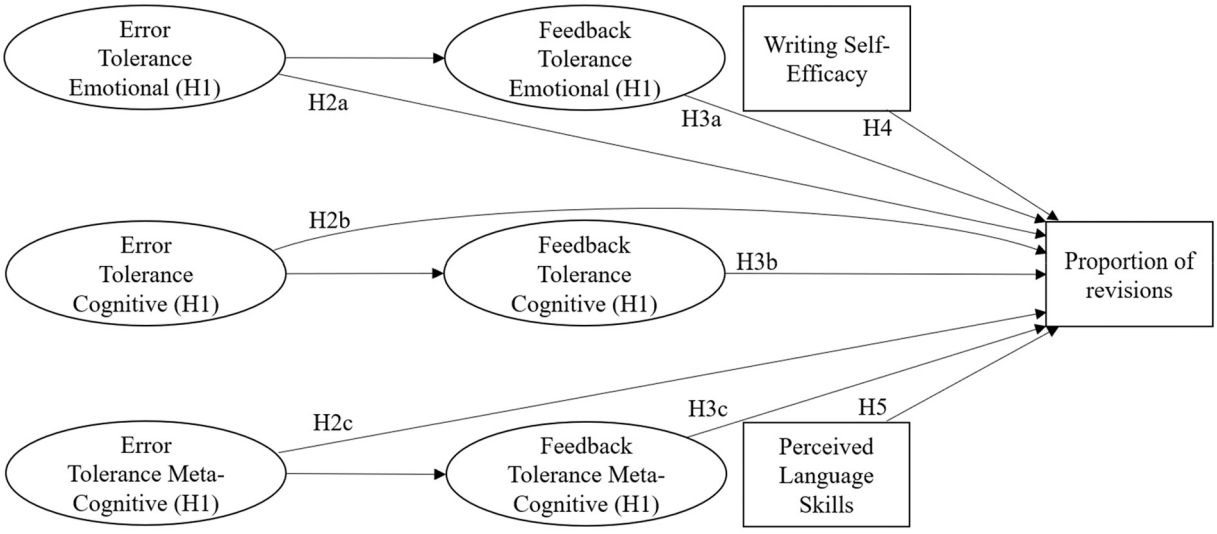


**Fig. 1.** Visualization of hypothesized relationships between error tolerance, feedback tolerance, writing self-efficacy, perceived language skills and the proportion of text revisions in line with peer-feedback.

language skills relate to the proportion of text revisions in line with peer-feedback on argumentative texts?

It was hypothesized that text revisions would be more often in line with feedback from a peer perceived to have stronger language skills than the own, compared to a peer perceived to have weaker language skills than the own (H5).

## 3. Method

### 3.1. Participants

A power analysis for a test of close fit (RMSEA) was conducted to determine the required sample size for this study, using the following specifications: $df = 390$,[1] $alpha = 0.05$, RMSEA under $H_0 = 0.05$, RMSEA under $H_a = 0$, and a desired power of 0.80. This revealed that a sample size of at least 80 students was required (MacCallum et al., 1996). This required sample size was substantially exceeded, because a sample of at least 150 participants was required for the first part of the diptych to which this study belongs. Therefore, a total of 238 10th grade students from nine classes across three Dutch secondary schools (School 1: 5 classes, School 2: 3 classes, School 3: 1 class) participated in two sessions of data collection, however, only 160 participants were included in the analyses ($n_{school1} = 74$; $n_{school2} = 62$; $n_{school3} = 24$; $M_{age} = 15.1$; $SD_{age} = 0.51$) for this study. Reasons for exclusion were absence during either the first or the second session of data collection ($n = 43$), a failed manipulation in one class because the students in this class inferred that they were processing feedback manipulated by the researchers ($n = 27$), students who failed to save their produced text ($n = 5$), participation in a related pilot ($n = 2$), and lack of parental permission to use their child's data ($n = 1$).

### 3.2. Design and procedure

Prior to data collection, the proposal for this study was approved by the ethics committee of the University of Groningen. The data were collected in the context of the school subject 'Dutch'. The participants attended two sessions, each consisting of two consecutive 50-min lessons on two regular school days. During the first session, students provided informed consent if they agreed to participate, after which they had to write an argumentative text individually, on a laptop within 40 min. The text aimed to defend the standpoint that self-driving cars would make traffic safer in the future (task based on Vandermeulen, 2020). We provided them with three sources of information on the topic to support writing their text. Hereafter, participants completed a questionnaire about their error tolerance, feedback tolerance, and a questionnaire in which they indicated for each of their classmates how they perceived that classmates' language skills relative to their own language skills.

The second session was intended to take place after one or two weeks. However, due to school schedules and vacations, this was not feasible in all cases; hence, the time-lag between sessions varied from 1 to 11 weeks (School 1: 3 weeks, School 2: 11 weeks, School 3: 1 week). During this session, participants had 40 min to provide feedback on two texts supposedly written by peers—in reality the content of the texts was manipulated by the researchers and was identical for all students. They were instructed to use comments and track changes in *Microsoft Word*, and they saved their feedback on separate USB-drives. Hereafter, they completed a questionnaire that measured their writing self-efficacy.

Subsequently, they received feedback on the text they had written during the first session under the illusion that the feedback was provided by one of their peers during the second session. The students had 25 min to process the feedback and improve their text. In reality, all participants received similar feedback, which was provided by trained research-assistants in between session one and two. The research-assistants were Master students working in the fields of Psychology, Educational Sciences, Sociology, and Language and Communication. In order to make the students believe that they processed peer-feedback, the researcher in the class collected the USB-drives with feedback provided by the students in a bag, and replaced this bag by an identical bag with similar USB-drives with the manipulated feedback. Using USB-drives enabled us to execute the intervention at the participating schools in an identical manner, independent of the digital systems these schools were using. Additionally, we avoided potential problems caused by a faltering internet connection. See Fig. 2 for a schematic visualization of the procedure.

Half of the participants was led to believe that the feedback they had to process was provided by a classmate whom they had assessed as a peer with stronger language skills than their own during the first session.

[1] Expected degrees of freedom ($d$) were calculated using the formula $d = p(p + 1)/2 - q$, with $p$ = number of variables and $q$ = the number of free parameters (MacCallum et al., 1996). The number of free parameters ($q$) for Model D = 30 observed variable variances, 24 factor loadings, 6 latent variable variances, 9 regression paths, and 6 latent variable covariances = 75. $d = 30(31)/2–75 = 390$.

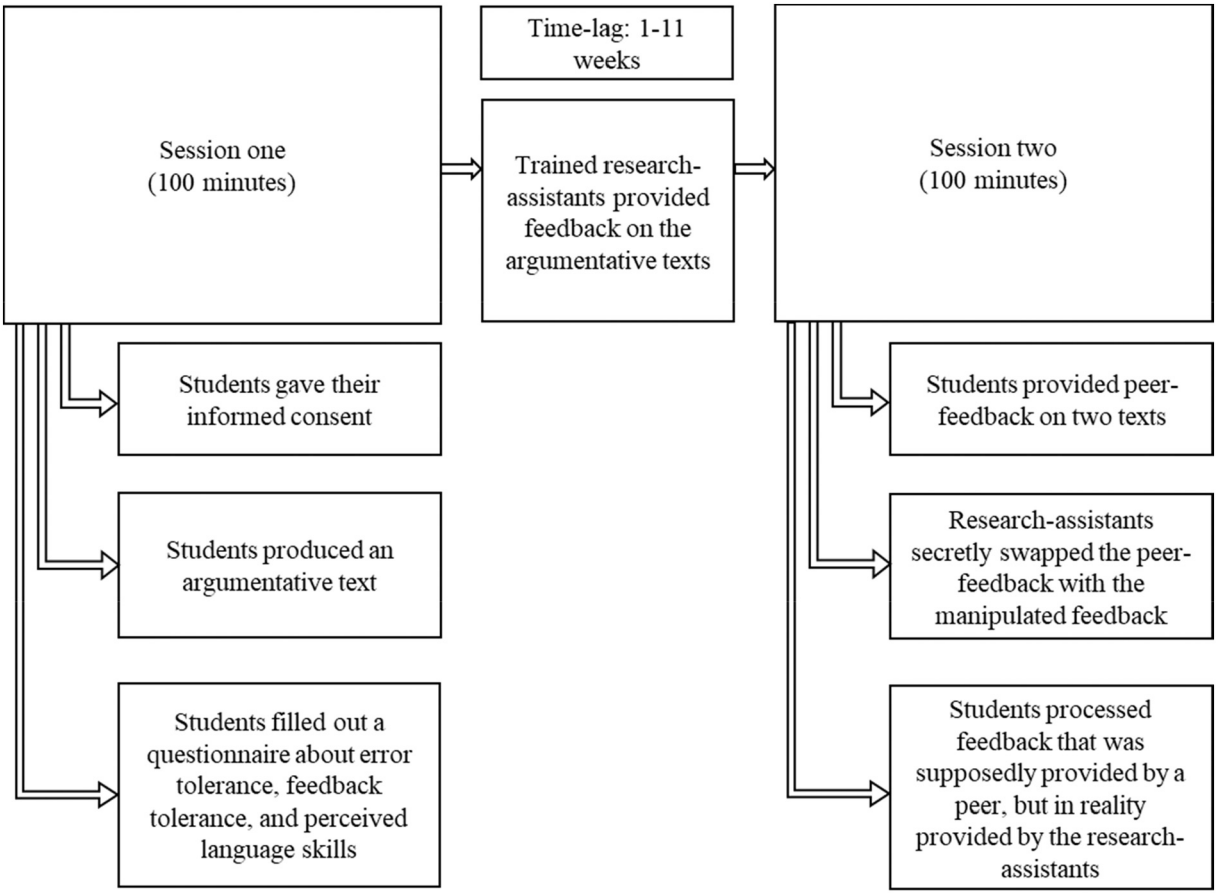


**Fig. 2.** Schematic visualization of the procedure of data collection.

The other half of the participants was led to believe that the feedback they had to process was provided by a classmate whom they had assessed as a peer with weaker language skills than their own during the first session. Assignment to one of the conditions happened randomly for 65 % of the participants. There was forced assignment to one of the conditions for 35 % of the participants, as they had indicated to perceive all peers to have stronger language skills than their own, weaker language skills than their own, or language skills equally strong as their own. For those participants, feedback providers were chosen whose language skills the rest of the class had indicated to perceive as either strong or weak. To ensure that the same participant was not selected as 'feedback provider' over and over again for different classmates, each participant was allowed to be the 'feedback provider' for a maximum of four times. Of all participants, 24.3 % was chosen as 'feedback provider' zero times, 54.4 % once, 18.8 % twice, and 2.5 % three times.

The participants were informed about the alleged identity of the feedback provider by the name of the *Word* file that contained their text. The file name was composed as follows: [first name author text]_[last name author text]_feedback_provided_by_[first name feedback provider]_[last name feedback provider]. It is likely that all students noticed the name of the 'feedback provider', as they were prompted to look at the file names because they had to save the files in which they provided feedback in the same way. Students had to double click the file name in order to open the document.

The participants were instructed as follows: "You will now process the feedback. It may be the case that someone provided feedback that you do not agree with. It is not obligatory to use all the feedback you received. You are the writer of your text. The aim is to write a text that is as good as possible". The students were asked to save a final document without leaving in any of the feedback remarks. The second session ended with a debriefing explaining the manipulation. The debriefing did not reveal any signs of students having noticed the USB-bag shift.

### 3.3. Materials

The feedback that we provided to the participants had to be (1) similar for all students, independent of text quality, and (2) as text-specific as possible—yet, simultaneously (3) abstract enough so that any student would believe that the feedback could have been produced by a classmate, and (4) phrased in such a way that it would resemble, as closely as possible, how a 10th grade student would phrase feedback. In order to deal with this tension adequately, a pilot study was performed to determine characteristics of typical 10th grade peer-feedback in terms of function (i.e., communicative message, e.g., suggestion, justification, correction), focus (e.g., spelling, writing style, paragraph structure), and lay-out. Thirty-one 10th grade students produced a text based on the same assignment about self-driving cars, and provided real peer-feedback to one of their classmates. The pilot revealed that the students (a) mainly made in-text changes, and provided negative comments and suggestions, (b) focused mainly on writing style, and occasionally on lower and higher order concerns, and (c) provided feedback using both *Microsoft Word*'s functions *track changes* and *comment balloons*.

These observations served as the base for a manual that was developed for the trained research-assistants that provided the feedback in between the two sessions. The manual contained a stepwise procedure to provide a total of 14 feedback remarks to each students' text. All 14 remarks were based on actual feedback provided in the pilot, and required action as they consisted of in-text changes using 'track changes', or a suggestion or negative remark in a comment balloon. Four remarks focused on lower order concerns (interpunction, spelling, and grammar), six remarks focused on writing style (word choice and phrasing), and four remarks focused on higher order concerns

(understandability, paragraph structure, text structure, and argumentation). Five of the feedback remarks additionally contained an elaboration in a comment balloon (i.e., a justification, informative remark, or negative remark). For each of the 14 remarks, several alternative phrasings were developed in order to provide feedback to all produced texts, also when the intended remark was not applicable. All alternatives were similar in length and sentence complexity, and expected to be similar in processing time and complexity. See Table 1 for a brief overview and section 1 in the supplemental material for the full manual.

### 3.4. Instruments

#### 3.4.1. Perceived language skills

Perceived language skills were measured by asking: "How good are your classmates in the school subject Dutch, compared to you?". The sentence was followed by a list of all classmates for whom the participants had to indicate how they perceived each classmates' language skills (range: 1: "a lot worse than I am", 2: "a bit worse than I am", 3: "about as good as I am", 4: "a bit better than I am", 5: "a lot better than I am"). The average rating of peers perceived to have weaker language skills than the own was 2.18 ($SD = 0.75$), and the average rating for peers perceived to have stronger language skills than the own was 4.23 ($SD = 0.64$).

#### 3.4.2. Error tolerance

Rybowiak et al. (1999) distinguished eight components in their Error Orientation Questionnaire. Their 'error strain' component served as the base for the emotional component of error tolerance, their 'learning from errors' component served as the base for the cognitive component, and their 'thinking about errors' as the base for the meta-cognitive component. The items were rephrased to connect to the context of written peer-feedback, in the domain of writing, with respect to the particular age group of this study. Emotional error tolerance was measured with six items, such as "I am afraid of making mistakes". Cognitive error tolerance was measured with four items, such as "Mistakes assist me to improve my work". Meta-cognitive error tolerance was measured with five items, such as "After I have made a mistake, I think about how it came about". All error tolerance items had to be answered on 5-point Likert-scale ranging from 1 (*completely disagree*) to 5 (*completely agree*).

#### 3.4.3. Feedback tolerance

King et al. (2009) distinguished four components in their Instructional Feedback Orientation Scale. Their 'sensitivity' component served as the base for the emotional component of error tolerance, and their 'utility' component served as the base for the cognitive and meta-cognitive components. We reviewed the content of the items of the 'utility' component and determined whether it measured the extent to which individuals view feedback as important for learning (i.e., cognitive component) or the extent to which one takes time to think about feedback (i.e., meta-cognitive component). The items were rephrased to connect to the context of written peer-feedback, in the domain of writing, with respect to the particular age group of this study. Emotional feedback tolerance was measured with eight items, such as "My feelings can easily be hurt by corrective feedback from a classmate". Cognitive feedback tolerance was measured with four items, such as "I think feedback from classmates is vitally important in improving my text". Meta-cognitive feedback tolerance was measured with three items, such as "I will usually reflect on a classmate's feedback". All feedback tolerance items had to be answered on 5-point Likert-scale ranging from 1 (*completely disagree*) to 5 (*completely agree*).

#### 3.4.4. Writing self-efficacy

Writing self-efficacy was measured with five items based on Marsh (1990), such as "Compared to classmates I am good at text writing", and had to be answered on a 5-point Likert scale ranging from 1 (*completely disagree*) to 5 (*completely agree*).

The original and translated item phrasings for all error tolerance, feedback tolerance, and writing self-efficacy items can be accessed in section 2 of the supplemental material. For these three constructs, the scale analysis is described in the results section.

**Table 1**
Brief overview of feedback provided to the students according to the feedback provision manual.

| Number | Focus | Sub focus | Remark requiring action | Elaboration? | Example of remark |
|---|---|---|---|---|---|
| 1 | Lower order | Punctuation | In-text change | No | [ADDITION] [comma] |
| 2 | Lower order | Punctuation | In-text change | No | [DELETION] [space] |
| 3 | Lower order | Spelling | In-text change | No | [SUBSTITUTION] → a lot |
| 4 | Lower order | Grammar | In-text change | No | [SUB] self-driving cars […] → play |
| 5 | Writing style | Word choice | In-text change | Informative remark + justification | [SUB] → cars that can drive themselves. + "I changed it into cars that can drive themselves" + "because then you won't have to use the same words over again". |
| 6 | Writing style | Word choice | In-text change | No | [SUB] → casualties |
| 7 | Writing style | Formulation | In-text change | No | [SUB] → Beside |
| 8 | Writing style | Formulation | In-text change | No | [SUB] Accidents → are often caused by |
| 9 | Writing style | Formulation | Suggestion | Negative remark | "I don't like this". + "Maybe you can change it into [text specific suggestion]'." |
| 10 | Writing style | Formulation | Suggestion | Justification | "You could also change this into [text specific suggestion]" + "because then the sentence flow is a bit smoother." |
| 11 | Higher order | Understandability | Negative remark | No | "This part is not understandable for the reader." |
| 12 | Higher order | Paragraph structure | Suggestion | No | "Maybe you can also draw the attention in the introduction." |
| 13 | Higher order | Text structure | Suggestion | Justification | "I think you could even better divide the text in three or four paragraphs in introduction, body, conclusion" + "because then it is easier to read." |
| 14 | Higher order | Argumentation | Suggestion | Informative remark | "In the body there should actually also be counter arguments." + "Could you add them?" |

### 3.5. Coding of text revisions

For each of the provided feedback remarks, we determined whether the corresponding text element was changed using the following categories: (1) the text element was not changed; (2) the text element was changed, but not as suggested or corrected; (3) the text element was changed, and partly as suggested or corrected; (4) the text element was changed as suggested or corrected. A PhD-student working in the field of peer-feedback and assessment was trained to code text revisions according to these categories. The training took 5.5 h (preparation: 0.5 h; coding a training set: 4 h; discussion training set: 1 h). A randomly chosen set of 10.6 % (i.e., 17 texts) of the total dataset (i.e., 160 texts) was coded by the PhD-student and the first author. The PhD-student had a background in Psychology, and the first author a background in Language and Communication. Both had sufficient experience with coding and quantitative data collections. During the coding, the coders were not aware of whether the recipient was led to believe and perceive that the peer-feedback provider had weaker or stronger language skills compared to themselves. The interrater reliability was excellent (Krippendorff's $\alpha = 0.89$–95 %; CI [0.84–0.94]). Hereafter, the first author coded the remaining 90 % of the data. Also for the first 10 %, the first author's coding was used for the analyses.

### 3.6. Data analysis

The four categories for text revisions were recoded into two categories, because most of the text elements that feedback remarks referred to were coded as 'not changed' (30.6 %) or as 'changed as suggested or corrected' (61.9 %), and hardly any revised text elements were coded as 'changed, but not as suggested or corrected' (3.5 %), or coded as 'changed, and partly as suggested or corrected' (4.0 %). The two recoded categories were defined as (1) revision not in line with feedback (former categories 1 and 2) and (2) revision in line with feedback (former categories 3 and 4). Hereafter, for all participants three proportions were calculated indicating the extent to which they revised their text in line with feedback on (1) lower order concerns, (2) writing style, and (3) higher order concerns.

#### 3.6.1. Measurement models

Using Lavaan in RStudio (Rosseel, 2012), Structural Equation Modeling (SEM) was adopted as statistical technique, as SEM enables one to specify and test measurement models, which explore how measured variables define constructs (Schumacker & Lomax, 2004). Additionally, SEM allows to extend measurement models to structural models, which combine multiple regression analyses with latent variables (Ullman & Bentler, 2003).

In order to answer the first research question (i.e., to what extent emotional, cognitive, and meta-cognitive components of error tolerance and feedback tolerance could be distinguished statistically), we tested five measurement models. The first four models stepwise increased in complexity (see also Hodapp & Benson, 1997), in order to verify the assumption that the components of error tolerance and feedback tolerance (in terms of emotional, cognitive, and meta-cognitive components) not only theoretically, but also empirically construed different latent variables. Model A loaded all items on one latent general tolerance variable; model B loaded all items on two latent variables, distinguishing between error tolerance and feedback tolerance; model C loaded all items on four latent variables, additionally distinguishing between an emotional and a cognitive component of error tolerance and feedback tolerance; and model D loaded all items on six latent variables, distinguishing between an emotional, cognitive, and meta-cognitive component of error tolerance and feedback tolerance. The fifth model, model E, approached the structure of latent variables differently by loading all items on three latent variables, distinguishing between an emotional, cognitive, and meta-cognitive component of tolerance in general.

For the construct writing self-efficacy, a measurement model was tested that was independent from the error tolerance and feedback tolerance constructs. This was tested separately because writing self-efficacy is a theoretically different construct than the more closely related error and feedback tolerance. The fit indices used for the evaluation of the measurement models were the Comparative Fit Index (CFI, "close to .95" or greater indicates a good fit; Hu & Bentler, 1999, p. 27), Root Mean Square Error of Approximation (RMSEA, $< 0.06$ indicates an acceptable fit; Schreiber et al., 2006), and Gamma Hat ($> 0.90$ indicates acceptable fit, $> 0.95$ indicates a good fit; Marsh et al., 2004). ΔCFI was used to compare the improvement of nested measurement models. The $\chi^2$ was ignored as the measured variables should have a multivariate normal distribution for a correct interpretation of $\chi^2$ (Curran et al., 1996), however, the measured variables did not have a multivariate normal distribution (Henze-Zirkler's MVN test: HZ = 1.00, $p < .001$; Korkmaz et al., 2014).

#### 3.6.2. Structural models

The best fitting error tolerance and feedback tolerance measurement model was extended with a structural part, measuring (1) the relations between the components of error tolerance and the proportion of text revisions in line with feedback, (2) to what extent these relations were mediated by the components of feedback tolerance, (3) the relation between writing self-efficacy and the proportion of text revisions in line with feedback, and (4) the relation between perceived language skills and the proportion of text revisions in line with feedback. Additionally, the variable 'school' was included as a covariate, to control for the differences between schools in time-lag between the first and second research session. Analyses were run separately for lower order concerns, writing style, and higher order concerns.

For the structural model, the diagonally weighted least squares (DWLS) estimator was used because the outcome variables (proportions of text revisions in line with feedback) were not-normally distributed. The variables, that were treated as categorical data, displayed either a zero inflated distribution (in the case of higher order concerns), or a one-inflated distribution (in the case of lower order concerns and writing style). DWLS is a robust estimator that can deal with non-normal distributions by using "the WLS estimator with polychoric correlations as input to create the asymptotic covariance matrix" (Newsom, 2018, p. 2).

## 4. Results

### 4.1. Data inspection

Each student received on average 13.4 feedback remarks. This was similar for students who believed that they had received feedback from a peer perceived to have stronger language skills than their own ($M = 13.4$, $SD = 1.08$) and students who believed that they had received feedback from a peer perceived to have weaker language skills than their own ($M = 13.4$, $SD = 1.13$). The range of provided feedback remarks varied from 10 to 16. The reason that students received less than the target number of 14 remarks ($n = 86$) was that not all 14 remarks were applicable for every text written by the students. The reason that some students received more than 14 remarks ($n = 21$), was that one of the four research-assistants that provided the feedback at a certain moment started misinterpreting the manual. In 22 cases this research-assistant corrected two spelling errors, instead of one, and in 39 cases two grammar errors were corrected, instead of one. However, as these deviations from the manual were small, and as the dependent variables were proportions, these cases were not excluded from the analyses.

Regarding missing data, across all respondents, 18 items were left unanswered or were answered in an unreadable manner. As this was only 0.33 %, the analyses were executed with pairwise deletion of missing values and without data imputation. The dependent variables did not contain any missing values as a result of their proportional nature. No values were considered outliers, as all items were answered on a predefined scale and because the outcome variables were proportional.

Five observed outcome proportional values had to be adapted to the adjacent value as the structural equation models did not allow proportional values to occur only for peers perceived as stronger or peers perceived as weaker. Three of the five values were adapted to the adjacent value in the opposite direction of our fourth hypothesis, and two were adapted in the direction of our fourth hypothesis, in order to limit bias and adopt a conservative approach. On average, students acted upon 84.3 % ($SD = 0.24$) of the feedback remarks on lower order concerns, 75.3 % ($SD = 0.24$) of the feedback remarks on writing style, and 31.4 % ($SD = 0.26$) of the feedback remarks on higher order concerns.

### 4.2. Measurement models

Table 2 shows that the measurement model for writing self-efficacy had a good fit to the data. Moreover, the error tolerance and feedback tolerance measurement model D, distinguishing between an emotional, cognitive, and meta-cognitive component of error tolerance and feedback tolerance, fitted the data better than the simpler models A, B and C, and the alternative model E. However, as even model D did not meet the prescribed evaluation criteria for model fit, model F was constructed by slightly adapting model D. In model F two of the eight items that measured the emotional component of feedback tolerance were left out, as the modification indices related to those two items appeared to be higher than 10.83 (i.e., $p$-value for model improvement <0.001; Ebesutani et al., 2010). Moreover, instead of emotions that are the result of feedback and that are activated while processing the feedback (e.g., feeling ashamed, threatened, intimidated), these two items measured reported behavior after feedback processing (i.e., "I tend to keep thinking about correcting peer-feedback") and the effect of feedback on actions in the future (i.e., "Correcting peer-feedback increases my stress level for texts I have to write in the future"). Model F met the prescribed evaluation criteria and was therefore used for further analyses. Hence, writing self-efficacy, and the six components of error tolerance and feedback tolerance construed different latent variables. Zero order correlations, means, standard deviations, reliabilities, and factor loadings are shown in Table 3.

### 4.3. Structural equation models

Table 4 displays the results for the structural equation models for lower order concerns, writing style, and higher order concerns. The results are reported for the direct relations (i.e., c1-c3 for the paths from the components of error tolerance to the outcome variables), the indirect relations (i.e., a1-a3 for the paths from the components of error tolerance to the components of feedback tolerance, and b1-b3 for the paths from the components of feedback tolerance to the outcome variables), and the relations between writing self-efficacy, perceived language skills, the covariate (i.e., school) and the outcome variables.

The fit was good of the structural equation models for lower order concerns, $\chi^2(608) = 772.79$, CFI = 0.951, RMSEA = 0.041, Gamma Hat = 0.939, writing style, $\chi^2(608) = 776.63$, CFI = 0.950, RMSEA = 0.042, Gamma Hat = 0.936, and higher order concerns, $\chi^2(608) = 769.10$, CFI = 0.945, RMSEA = 0.044, Gamma Hat = 0.930. As the paths from the components of error tolerance to the components of feedback tolerance were identical in the three models, the corresponding coefficients were identical as well. The emotional, cognitive, and meta-cognitive components of error tolerance were significantly associated with, respectively, emotional feedback tolerance ($\beta = 0.60$, SE = 0.09, $p < .001$), cognitive feedback tolerance ($\beta = 0.53$, SE = 0.24, $p < .001$), and meta-cognitive feedback tolerance ($\beta = 0.57$, SE = 0.06, $p < .001$).

The first structural model (Fig. 3) revealed that none of the variables of interest was significantly associated with the proportion of text revisions in line with feedback on lower order concerns, and that the associations between error tolerance components and feedback uptake were not mediated by feedback tolerance components. Simultaneously, the covariate school showed that students at school 3 made significantly fewer text revisions in line with feedback on lower order concerns than the students at school 1 ($\beta = -0.27$, SE = 0.35, $p < .05$).

The second structural model (Fig. 4) showed that students made significantly more text revisions in line with feedback on writing style when they believed that the feedback had been provided by a peer perceived to have stronger language skills than their own than when they believed that the feedback had been provided by a peer perceived to have weaker language skills than their own ($\beta = 0.21$, SE = 0.18, $p < .05$). None of the other variables of interest was significantly associated with the proportion of text revisions in line with feedback on writing style, and the associations between error tolerance components and feedback uptake were not mediated by feedback tolerance components. Simultaneously, the covariate school showed that students at school 2 made significantly more revision in line with feedback on writing style than the students at school 1 ($\beta = 0.20$, SE = 0.17, $p < .05$).

Finally, the third structural model (Fig. 5) illustrated that none of the variables of interest was significantly associated with the proportion of text revisions in line with feedback on higher order concerns, and that the associations between error tolerance components and feedback uptake were not mediated by feedback tolerance components. Simultaneously, the covariate school showed that students at school 2 made significantly more text revisions in line with feedback on higher order concerns than the students at school 1 ($\beta = 0.24$, SE = 0.18, $p < .05$).

**Table 2**
Characteristics of the measurement models for writing self-efficacy and for feedback and error tolerance.

| Model | $\chi^2$ | df | $\chi^2$/df | CFI | RMSEA | Gamma Hat | Model for comparison | $\Delta\chi^2$ | Δdf | $p$ | ΔCFI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Writing self-efficacy | 10.37 | 5 | 2.07 | 0.983 | 0.082 | 0.987 | N.A. | | | | |
| A (general tolerance) | 1319.18 | 405 | 3.26 | 0.449 | 0.119 | 0.717 | | | | | |
| B (error + feedback tolerance) | 1192.55 | 404 | 2.95 | 0.525 | 0.109 | 0.751 | A | 126.63 | 1 | <0.001 | 0.076 |
| C (emotional + cognitive error + feedback tolerance) | 618.66 | 399 | 1.55 | 0.868 | 0.060 | 0.910 | B | 573.89 | 5 | <0.001 | 0.343 |
| D (emotional + cognitive + meta-cognitive error + feedback tolerance) | 568.96 | 390 | 1.46 | 0.892 | 0.054 | 0.113 | C | 49.70 | 9 | <0.001 | 0.024 |
| E (emotional + cognitive + meta-cognitive tolerance) | 776.91 | 347 | 2.24 | 0.723 | 0.088 | 0.843 | N.A. | | | | |
| F (model D + adaptation) | 448.72 | 335 | 1.34 | 0.927 | 0.046 | 0.953 | D | 120.24 | 55 | <0.001 | 0.035 |

*Note.* $X^2$ = chi-square; df = degrees of freedom; $\Delta\chi^2$ = difference in chi-square estimates across two nested models; Δdf = difference in degrees of freedom across two nested models; $p$ = $p$-value; ΔCFI = difference in comparative fit index across two nested models.

**Table 3**
Correlations among the latent variables, and means, standard deviations, and range of factor loadings per latent variable for model F (i.e., the model distinguishing between an emotional, cognitive, and meta-cognitive component of error tolerance and feedback tolerance, leaving out two items measuring the emotional component of feedback tolerance).

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1 | Error tolerance – emotional | – | | | | | | |
| 2 | Error tolerance – cognitive | 0.10 | – | | | | | |
| 3 | Error tolerance – meta-cognitive | 0.21** | 0.42** | – | | | | |
| 4 | Feedback tolerance – emotional | 0.51** | −0.11 | −0.03 | – | | | |
| 5 | Feedback tolerance – cognitive | 0.07 | 0.38** | 0.21** | −0.17* | – | | |
| 6 | Feedback tolerance – meta-cognitive | 0.19* | 0.37** | 0.36** | −0.15 | 0.59** | – | |
| 7 | Writing self-efficacy | −0.15 | 0.14 | 0.06 | −0.13 | 0.03 | 0.01 | – |
| | Mean | 2.17 | 3.78 | 3.39 | 1.50 | 3.69 | 3.79 | 3.22 |
| | Standard deviation | 0.89 | 0.52 | 0.72 | 0.57 | 0.53 | 0.61 | 0.60 |
| | CFA loadings range (mean) | 0.68–0.84 (.75) | 0.45–0.66 (.52) | 0.62–0.83 (.69) | 0.55–0.76 (.67) | 0.49–0.62 (.55) | 0.40–0.86 (.66) | 0.39–0.92 (.70) |

Note.
* $p < .05$.
** $p < .01$.

**Table 4**
Standardized and unstandardized coefficients for the structural equation models for lower order concerns, writing style, and higher order concerns.

| Latent variable | Lower order concerns | | | | Writing style | | | | Higher order concerns | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | β | B | SE | *p* | β | B | SE | *p* | β | B | SE | *p* |
| Predicted variable: proportion of text revisions in line with feedback | | | | | | | | | | | | |
| ET – emotional (c1) | 0.01 | 0.02 | 0.27 | 0.95 | 0.30 | 0.48 | 0.36 | 0.19 | 0.14 | 0.21 | 0.29 | 0.46 |
| ET – cognitive (c2) | −0.75 | −2.72 | 6.55 | 0.68 | −1.17 | −4.21 | 7.89 | 0.59 | 0.81 | 2.89 | 6.12 | 0.64 |
| ET – meta-cognitive (c3) | 0.77 | 1.20 | 2.96 | 0.68 | 1.06 | 1.64 | 3.62 | 0.65 | −0.71 | −1.09 | 2.86 | 0.70 |
| Writing self-efficacy | 0.07 | 0.01 | 0.16 | 0.42 | −0.03 | −0.06 | 0.14 | 0.67 | 0.00 | 0.00 | 0.15 | 1.00 |
| Percep. provider (strong) | 0.06 | 0.13 | 0.20 | 0.51 | 0.20 | 0.41 | 0.17 | 0.02 | −0.02 | −0.03 | 0.17 | 0.85 |
| Predicted variables: components of feedback tolerance | | | | | | | | | | | | |
| ET – Emotional (a1) | 0.60 | 0.51 | 0.09 | <0.001 | 0.60 | 0.51 | 0.09 | <0.001 | 0.60 | 0.51 | 0.09 | <0.001 |
| ET – Cognitive (a2) | 0.53 | 0.73 | 0.24 | <0.001 | 0.53 | 0.72 | 0.24 | <0.001 | 0.53 | 0.72 | 0.24 | <0.001 |
| ET – meta-cognitive (a3) | 0.57 | 0.23 | 0.06 | <0.001 | 0.57 | 0.23 | 0.06 | <0.001 | 0.57 | 0.23 | 0.06 | <0.001 |
| Predicted variable: proportion of text revisions in line with feedback | | | | | | | | | | | | |
| FT – emotional (b1) | −0.016 | −0.03 | 0.45 | 0.95 | −0.23 | −0.42 | 0.61 | 0.49 | −0.01 | −0.02 | 0.43 | 0.97 |
| FT – cognitive (b2) | 1.21 | 3.20 | 8.53 | 0.71 | 1.70 | 4.52 | 10.44 | 0.67 | −1.12 | −2.96 | 8.19 | 0.72 |
| FT – Meta-cognitive (b3) | −1.25 | −4.74 | 12.13 | 0.67 | −1.65 | −6.26 | 14.80 | 0.67 | 1.19 | 4.50 | 11.67 | 0.70 |
| Covariate: predicted variable: proportion of text revisions in line with feedback | | | | | | | | | | | | |
| School (2) | −0.16 | −0.34 | 0.23 | 0.14 | 0.20 | 0.42 | 0.18 | 0.02 | 0.24 | 0.51 | 0.18 | 0.01 |
| School (3) | −0.27 | −0.77 | 0.35 | 0.03 | 0.08 | 0.24 | 0.31 | 0.44 | −0.01 | −.02 | 0.30 | 0.96 |
| Indirect effects | | | | | | | | | | | | |
| Emotional tolerance | −0.01 | −0.02 | 0.23 | 0.95 | −0.14 | −0.22 | 0.32 | 0.50 | −0.01 | −0.01 | 0.22 | 0.97 |
| Cognitive tolerance | 0.64 | 2.33 | 6.40 | 0.72 | 0.91 | 3.26 | 7.79 | 0.68 | −0.60 | 2.13 | 6.03 | .72 |
| Meta-cognitive tolerance | −0.71 | 1.10 | 2.92 | 0.71 | −0.94 | −1.45 | 3.57 | 0.69 | 0.68 | 1.05 | 2.80 | 0.71 |

*Note.* ET = Error tolerance, FT = Feedback tolerance; a1–a3 refer to paths from the components of error tolerance to the components of feedback tolerance, b1–b3 refer to paths from the components of feedback tolerance to proportion of text revisions in line with feedback, c1–c3 refer to paths from the components of error tolerance to the proportion of text revisions in line with feedback, indirect effects refer to mediation paths.

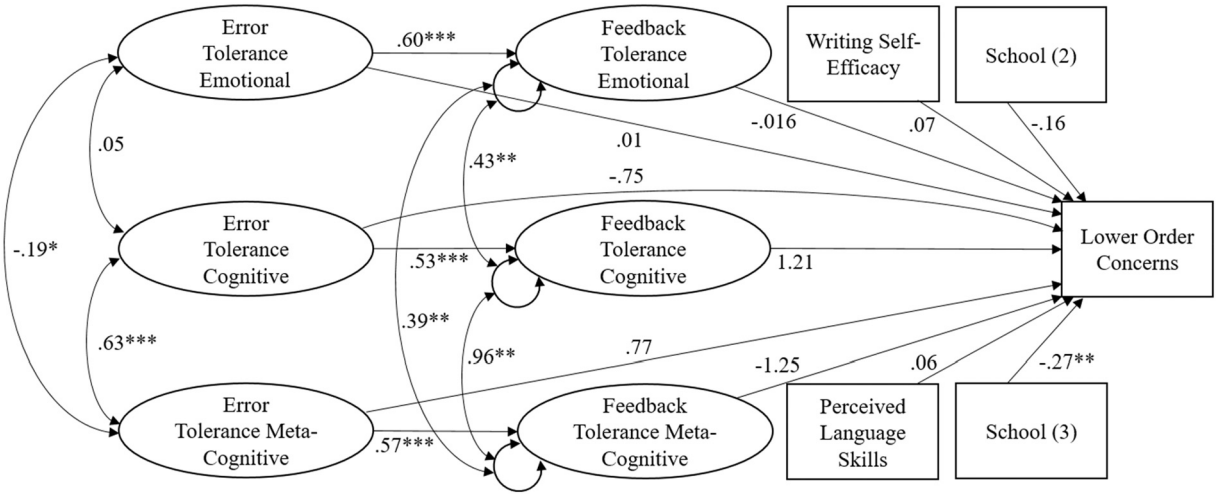


**Fig. 3.** Standardized coefficients and covariances for the structural equation model for lower order concerns, *** $p < .001$, ** $p < .01$, * $p < .05$.

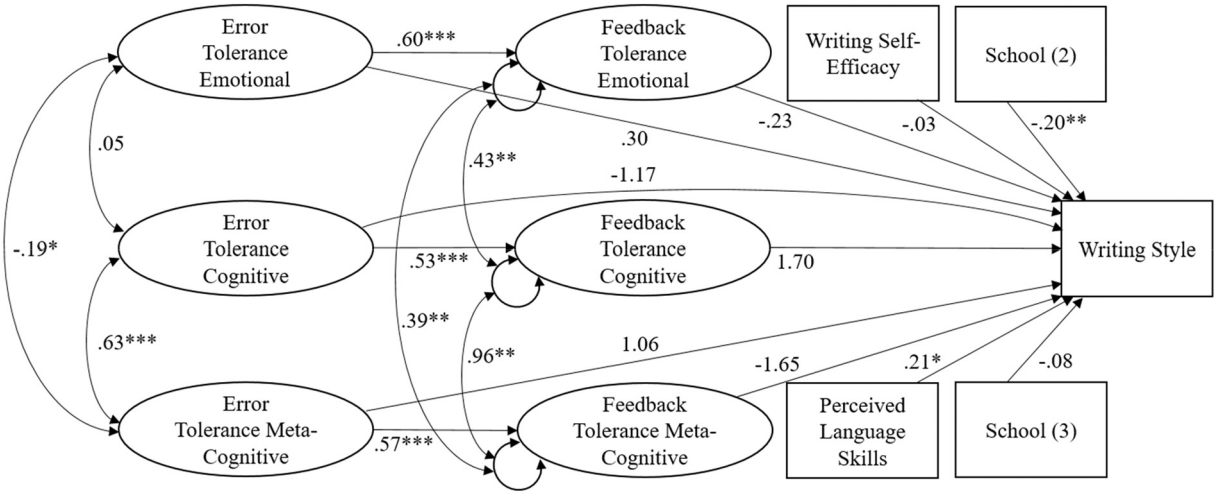


**Fig. 4.** Standardized coefficients and covariances for the structural equation model for writing style, *** p < .001, ** p < .01, * p < .05.

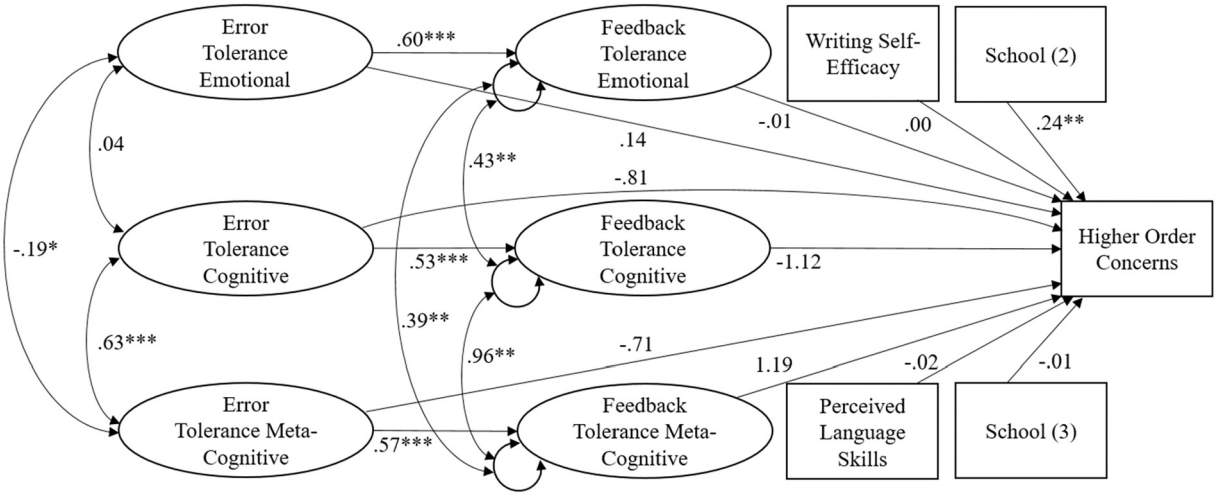


**Fig. 5.** Standardized coefficients and covariances for the structural equation model for higher order concerns, *** p < .001, ** p < .01, * p < .05.

## 5. Discussion and conclusion

The aim of this study was to investigate relations between intrapersonal factors (i.e., error tolerance, feedback tolerance, and writing self-efficacy), interpersonal factors (i.e., perceived language skills) and the uptake of peer-feedback on an argumentative text in the school subject 'Dutch'. In an experimental design, secondary school students processed feedback under the illusion that this feedback had been provided by one of their peers, whereas this feedback in reality had been manipulated by the researchers. The results showed that students almost always revised their text in line with peer-feedback on lower order concerns, independent of the perception of the provider's language skills. Similarly, students hardly revised their text in line with peer-feedback on higher order concerns, again independent of the perception of the provider's language skills.

A first goal was to determine whether error tolerance and feedback tolerance could both be distinguished statistically as consisting of an emotional, cognitive, and meta-cognitive component, based on the theoretical distinctions by King et al. (2009) and Rybowiak et al. (1999) and whether they would be associated with peer-feedback uptake. The results showed that a measurement model including all six components fitted the data best, indicating that they could not only theoretically, but also empirically be distinguished for secondary school students (H1 was confirmed). Furthermore, neither one of the error tolerance and feedback tolerance components (H2), nor writing self-efficacy (H4) were significantly associated with the proportion of text revisions in line with the peer-feedback.

On the one hand, the non-significant relation between error tolerance, feedback tolerance, writing self-efficacy and peer-feedback uptake may indicate that such relation do not exist. On the other hand, the absence of significant associations may be caused by the students being not fully engaged with the task and/or the texts at hand (Nilson, 2003). For error tolerance or feedback tolerance to be related with peer-feedback uptake, it is important that contextual factors offer at least the opportunity that students become emotionally affected by their errors or the received feedback (Värlander, 2008). As this assignment was only assessed for formative purposes, they might have affected the students' reactions to the peer-feedback. As students are used to be mostly summatively assessed, they may neglect assignments and associated (peer) feedback that do not contribute to their final assessment (Harlen, 2006). Consequently, the assignment may have been perceived as an obligatory, extra-curricular activity, which may have prevented the occurrence of any relationships between intrapersonal factors of interest and peer-feedback uptake.

Additionally, we hypothesized that potential relations between error tolerance and peer-feedback uptake would be mediated by feedback

tolerance (H3). This was not found to be the case. Although none of the components of feedback tolerance related to peer-feedback uptake, the emotional, cognitive, and meta-cognitive components of error tolerance were found to be associated with corresponding components of feedback tolerance. These findings confirm the central role that errors or improvable performance elements play in the construct of feedback tolerance.

The importance of tolerance towards errors for explaining one's tolerance towards feedback closely relates to the concept of feedback literacy. Feedback literacy can be defined as "the understandings, capacities and dispositions needed to make sense of information and use it to enhance work or learning strategies" (Carless & Boud, 2018, p. 1316). Whereas previous research emphasized the importance of managing affect (e.g., feelings, emotions) in order to become feedback literate (Carless & Boud, 2018; Molloy et al., 2020; Sutton, 2012), our findings underscore that a fundamental part of one's feelings and emotions evoked by feedback appears to be affected by one's tolerance towards errors or improvable performance elements.

Finally, we expected that text revisions would be more often in line with feedback from a peer perceived to have stronger language skills than the own than from a peer perceived to have weaker language skills than the own (H5). This hypothesis could partly be confirmed. The hypothesized relation was not found for text revisions based on feedback on lower and higher order concerns, but it was found for feedback on writing style. Students who received feedback on writing style from a peer perceived to have stronger language skills than their own revised their text more often in line with the feedback than students who received feedback on writing style from a peer perceived to have weaker language skills than their own.

The contrasting results between the uptake of peer-feedback on lower order concerns and the uptake of peer-feedback on higher order concerns appears to be related to the nature of the text elements. Feedback on lower order concerns serves as the identification of errors that can hardly be discussed: in most cases, interpunction, spelling and/or grammar errors are undebatable (Lennon, 1991; Zwicky, 1980). Hence, acting upon the feedback may seem the logical, and easy thing to do, likely requiring little cognitive effort. By contrast, feedback on higher order concerns has, by nature, a more subjective character and processing consequently likely requires more cognitive effort, which seem to have led to students ignoring these feedback remarks.

In this line of reasoning, the relation between perceived language skills and the uptake of peer-feedback on writing style may be explained by the fact that the decision to process this kind of feedback requires a level of cognitive effort that is somewhere in between the level of cognitive effort required for deciding to act upon feedback on lower order concerns, and deciding to act upon feedback on higher order concerns. That is, whereas students decided to nearly always act upon feedback on lower order concerns and decided to mostly ignore feedback on higher order concerns, they may have had to think more thoroughly about the decision to act upon feedback on writing style. Perhaps writing style was something that students were more comfortable, willing and/or able to address, compared to the higher order concerns that required more complicated text revisions. At this point, students seemed to be partly guided in their decision to act upon the feedback on writing style by their perception of the feedback provider's language skills.

### 5.1. Limitations and future research

Next to the strengths of the study, such as the comparability of the provided feedback between students, the manipulation regarding the perceived feedback provider's language skills, and the high inter-rater reliabilities, the study carried several limitations. First, the students' motivation may have played a more substantial role than the study took into account. Clifford (1988) emphasized the role of motivation in relation to error tolerance and feedback tolerance, and also Zimmerman and Bandura (1994), and Wingate (2010) already pointed towards the relevance of motivation in relation to writing self-efficacy. As such, error tolerance, feedback tolerance, writing self-efficacy, and even the perception of the feedback provider's language skills may have had a more close relation with motivation than the current study accommodated. Hence, participants in future studies could be placed in settings that would induce more motivation for the task among students.

Second, the high context-dependency of students' peer-feedback uptake also became clear from the fact that the covariate school related to peer-feedback uptake. That is, students from school 2 made more often text revisions in line with the peer-feedback on writing style and on higher order concerns than students from school 1, and students from the school 3 made fewer text revisions in line with the peer-feedback on lower order concerns than students from school 1. These school effects may be explained by, for example, the quality of instructions that students normally receive when they are involved in peer-feedback activities. After all, previous research has already shown that the quality of instruction is vital for the quality of peer-feedback processing (Gan & Hattie, 2014; Graham & Perin, 2007).

Third, our design has some limitations. Although it was very likely that students noticed the manipulation of the name of the feedback provider while opening and saving the respective files, we do not have data supporting this claim. Therefore, some students may have processed the feedback while not having noticed the manipulation. More fundamental is the fact that not all participants could be randomly assigned to one of the two conditions. Although we dealt with this issue by using the average of the language skills as perceived by all class members, we acknowledge that the group formation may have been partly biased.

Fourth, this study's quantitative approach may have been too robust to capture small effects of intrapersonal and interpersonal factors, that cumulatively may contribute to explaining peer-feedback uptake. Theoretically, it might be the case that some relations between intrapersonal and interpersonal factors may occur for some students, but not for others. Therefore, future research should aim to also qualitatively investigate the complex interplay of intrapersonal factors, interpersonal factors, and feedback processing by means of think-aloud protocols and/or interview procedures.

### 5.2. Implications

The findings have several implications for the way teachers may deal with errors and interpersonal relationships in the peer-feedback practice. Although no explicit link between error or feedback tolerance and peer-feedback uptake was found, this study showed that error tolerance is a strong predictor of feedback tolerance, meaning that dealing with errors plays a crucial role in the process of dealing with feedback. Therefore, future endeavors could be aimed at developing interventions that may contribute to an error-tolerant classroom culture (e.g., Rach et al., 2012), by creating an atmosphere in which error making is approached as a valuable learning opportunity.

Additionally, the study should raise awareness of the relationship between students involved in peer-feedback activities. The learning gains of peer-feedback processing could be optimized if students and teachers involved are aware of the potential role that interpersonal factors may play in peer-feedback processing. Similarly, it may improve the quality of teachers' peer-feedback instructions when teachers would help students becoming aware of the role of interpersonal factors. Moreover, the awareness may lead to teachers consciously composing peer-dyads, for instance, by keeping into account the perceived language skills within dyads. Therefore, a potential area for future research is to address the way in which dyads can be composed the most efficiently, resulting in optimal learning gain.

## Declaration of competing interest

None.

## Acknowledgements

We would like to thank Margo Beer, Sjoerd Hekman, Ymke Riemersma, and Nelleke Varkevisser for their help with the data collection and the provision of feedback.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.lindif.2022.102175.

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