

# Contrasts of register underlie the perception of musical humor

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### Abstract

In the psychological literature on musical humor, the emphasis on laughter-inducing music has naturally led researchers to focus on quite uncommon devices, such as stylistic deviations or formal incongruities which strongly violate listeners' expectations, as the privileged basis for musical humor. But musical humor extends well beyond laughter-inducing music. It is also a kind of semantic content frequently ascribed to music, as attested by the long list of musical genres which are more or less explicitly associated with humor, wit, or comedy. As such, the communication of musical humor should be able to also rely on non-deviant compositional techniques – i.e., compositional techniques that conform to the standard syntax in which the musical output is generated. In this paper, we show that selectively augmenting or inhibiting contrasts of register found in passages of Cécile Chaminade's humorous piano music impacted the extent to which both expert and non-expert listeners rated such passages as expressing something humorous. We then analyze the effects of contrasts of register in light of incongruity and play theories of humor, and further discuss the relevance of our results for the semantics and pragmatics of music.

## 1. Introduction

Both humor and music lie at the cornerstone of our human lives: they are two cultural practices and two means of communication universally shared by humans (Fry, 1994; Mehr et al., 2019), to the point that they are sometimes taken as defining ingredients of what makes us human. While there is now a very large body of empirical psychological research on each of these two phenomena taken separately, there are comparatively few studies on their intersection (for bibliographic and meta-analytic data, see Lowry, 1974; Arias, 2001; Nissan, 2012; Kokkidou, 2012; Haire & MacDonald, 2019).

Most of the empirical research on musical humor focuses on what might be called *laughter-inducing (or evoking) music*, i.e., music that causes in the listener an emotional and behavioral reaction such as laughter, smiling or feeling of amusement. The first experimental observations on laughter-inducing music took place in fact within more general studies on emotions and meaning in music (Schoen, 1927; Hevner [Mueller], 1935, 1936, 1937; Campbell, 1942). Mull's (1949) pioneering study was the first to focus solely on the issue of laughter-inducing music. The aim of her study was to demonstrate correlations between certain formal and acoustic musical features and the listener's sense of amusement. Mull asked the participants to identify the passages they considered amusing within three works of program music, first by hiding the program from them and then by providing it to them. She found that, whatever the formal or acoustic parameter considered (register, tempo, duration, timbre, etc.), contrasts in the values taken by a given parameter were the feature most often present in passages judged humorous.

Subsequent studies have extended the research path opened by Mull (1949) in three directions: first, by attempting to further identify the formal and acoustic parameters that elicit laughter, smiling, or amusement (Huron 2004, 2006; Rozin et al., 2006, Nagy et al., in progress); second, by investigating how such laughter, smiling, or amusement responses varied as a function of personal variables such as age (LeBlanc et al., 1992; Smith, 1994), nervousness (Lassauzet, 2020), and musical expertise (Moore & Johnson, 2001); third, by studying the effects of laughter-inducing music – or, more broadly, of music combined with non-musical humorous stimuli – in education (Freeman, 1952; Streat, 2011) and art therapy (Szabo et al, 2005; Haire & Oldfield, 2009; Haire & MacDonald, 2019, 2021), particularly in relation to improvisation and ludic activity (Amir, 2005; Stensaeth, 2017).

While musical humor remains a relatively marginal topic within the psychology of music, research on musical humor in musicology, ethnomusicology, and more generally, the humanities and social sciences, is a striving field. Arias (2001) counted 832 publications on musical humor in the humanities and social sciences. In addition, since 2001, numerous large-scale publications have appeared, from individual publications and dissertations (Brown, 2007; Zank, 2009; Blanchet, 2010; Ellis, 2012; Palmer, 2015; Bourne, 2016; Eriksen, 2016; Goeth, 2016; Cherlin, 2017; Cummins, 2017; Martinez, 2017; Lassauzet, 2019; Krol, 2021) to ambitious edited collections (Loriot & Roubet, 2010; Guillebaud & Stoichita, 2013; Jung-Kaiser & Diedrich, 2015; Loriot, 2015; Turner, 2015; Kippelen, 2017; Joubert & Le Touzé, 2017; Kitts & Baxter-Moore, 2019).

A striking aspect of this literature is the variety of the repertoires addressed, which venture far beyond the few canonical examples of the Western classical repertoire usually considered in the studies on musical humor mentioned earlier (e.g., Haydn, Mozart (*A Musical Joke* K. 522), Beethoven, Saint-Saëns (*The Carnival of the Animals*), Richard Strauss (*Till Eulenspiegel*), Satie, or Peter Schickele aka P.D.Q. Bach). It includes music composed or performed in war contexts (Ellis, 2010; Korczynski, 2011; Turner, 2015; Benoit-Otis et al., 2016, Despoix et al., 2018), sacred and ritual music (Goldberg, 1993; Guillebaud & Stoichita, 2013; Jung-Kaiser &

Diedrich, 2015), film music (Mera, 2002; Biancorosso, 2009) and other video-accompanying music (Liikkanen & Salovaara, 2015; Dinnen, 2016), jazz, rock and popular song (Guerpin, 2010; Wise, 2012; Ellis, 2012; Kitts & Baxter-Moore, 2019), Javanese gamelan (Sutton, 1997; Benamou, 2013), South Indian music (Guillebaud, 2013), Romani music (Stoichita, 2008), Turkish and Arabic music, (Cler, 2010; Lambert, 2013), South African music (Martin, 2013; Pietilä, 2019), French rural music (Etay, 2013; Nyawalo, 2019), various genres of comic opera (Vendrix, 1992; Cailliez, 2014; Lorient, 2015; Hawig and Riemer, 2018), European medieval and Renaissance music (Minamino, 2001; Canguilhem, 2015; Singer, 2016), Western composers whose humor has been overlooked such as Lully (Arnason, 2011), Debussy (Wong, 2016; Lassauzet, 2019), Ravel (Zank, 2009), Rachmaninoff (Erkisen, 2016) and Bartok (Brown, 2007), and post-war Western avant-garde music (Boura, 2008; Kippelen, 2017).

The sheer length of this list clearly reflects that, within the musicological literature, musical humor is taken to extend well beyond music that elicits laughter, which, as David Huron himself plainly admits, “is not a common response in music” (Huron, 2006: 287). Here, musical humor is not only envisioned as a type of experience and reaction but also as a semantic and communicative phenomenon – as a type of content of the musical stimulus communicated by the composer and the musicians. To draw on a distinction that is often made in the field of musical emotion studies, the focus within the musicological literature seems to be more on humor-as-musically-expressed (or communicated) than on humor-as-musically-aroused (or caused) (Davies, 2010; see also Walton, 1993 and London, 2002 for an application of this distinction to the phenomenon of musical humor).

Such a focus on the semantic aspects of musical humor has the benefit of bringing musical humor closer to humor in general (Houseman, 2013; Kitts & Baxter-Moore, 2019; Crépiat, 2021). It also frames musical humor as a communicational phenomenon, precisely relying on the listeners’ ability to recognize that the music is produced with the intent to elicit comical amusement, beyond the mere monitoring of one’s own laughter reaction – which is not always a reliable indicator (see London 2021 for a discussion of musical performances that unintentionally elicit laughter). But more importantly, it forces us to consider musical humor as a somewhat banal phenomenon, which is much more frequent and important in music in general than the arguably more exceptional cases of laughter-inducing music. In the psychological literature on musical humor, the emphasis on laughter-inducing music, such as Mozart’s *Musical Joke* or Peter Schikele’s musical parodies, has naturally led researchers to focus on quite uncommon devices, such as stylistic deviations or formal incongruities which strongly violate listeners’ expectations (in the sense of Meyer, 1956), as the privileged basis for musical humor. But one might wonder how musicians and composers actually proceed in the much more frequent cases in which they simply want to musically express or represent something humorous, and not necessarily elicit laughter among their audience. Given how common it is for musicians to attempt at creating music that has some humorous content, it would seem reasonable to assume that such attempts do not require the introduction of the same kind of strongly incongruous or unexpected musical elements but rather rely on non-deviant compositional techniques – i.e., compositional techniques that conform to the standard syntax in which the musical output is generated.

In the present paper, we report on a study that precisely aimed at showing in a systematic way that such non-deviant compositional techniques can underlie the communication of musical humor. To make our case, we chose to focus here on how the manipulation of contrasts of register (i.e., the presence of a clear difference in pitch register between two adjacent musical elements) might contribute to our perception of musical humor. Two main reasons guided this choice.

First, contrasts of register seem to be frequently used by composers wishing to communicate humorous content, as evidenced by many musicological analytical insights and case studies on

this subject (Rosen, 1971; Kidd, 1976; Perry-Camp, 1979; Dalmonte, 1995; Casablancas, 2000; Sheinberg, 2000; Gooley, 2005; Ravas, 2005; Brown, 2007; Wise, 2012; Palmer, 2015; Cherlin, 2017; Lassauzet, 2019; Krol, 2021), as well as some writings coming directly from composers, musicians and critics (Briard, 1884; Russell, 1985-1986; Goeth, 2016). This is also consistent with the results of Mull's (1949) pioneering study, which concluded that contrast (of register or any other formal parameter) were a key compositional strategy in eliciting amusement.

Second, register is a parameter that can be easily manipulated experimentally: a given configuration of register (e.g., a contrast between two registers) can be inhibited or increased with fine grained variations but without having to modify other parameters, thus without altering the rest of the musical stimulus. This is an important methodological advantage compared to contrasts involving other syntactical parameters that might induce a significant alteration of the musical stimulus when manipulated (e.g., the contrast between two chords, between major and minor modes, between two pitches or between two durations).

The goal of our study was thus to selectively manipulate contrasts of register in passages of music explicitly composed to express a humorous content, in order to see whether such contrasts impacted the perception of the music's humorous content by third-party listeners. Our [pre-registered](#) hypothesis was that increased contrasts would lead to a higher tendency to judge a musical excerpt as expressing a humorous content whereas inhibited contrasts would lead to a lower tendency to judge the same musical excerpt as expressing a humorous content. Moreover, we also pre-registered the hypothesis that contrasts of register would only influence the ratings of humorous content, but not the ratings of emotional expressivity. In other words, our hypothesis here was that contrasts of register were not acting as a mere intensifier, indiscriminately making more salient whatever semantic or expressive properties ascribed to the music, but rather played a causal role in the communication of the music's humorous content. To put this hypothesis to a stringent test, our study thus also assessed the impact of contrasts of register on the perception of the music's joyful content, given how close joy and humor are generally taken to be, through mirth or exhilaration, i.e. the kind of joy and pleasure aroused by humor (Panksepp, 2000; Martin, 2006; Amir et al, 2015).

## 2. Methods

### 2.1. Participants

We recruited two groups of participants for this study, one group of non-musicians (musical practice < 2 years, N = 34, age = 24.7, max:35, min:19, female:15, male: 19) and one group of musicians (musical practice > 8 years of musical practice, N = 33, age = 24.5, max:38, min:18, female:27, male: 6). Group size was determined based on a power analysis relying on a pilot experiment (using a similar design, albeit with partly different stimuli) which indicated that we should test 30 participants to have a power of 80% at the 0.05 alpha level. Both groups of participants were recruited through the [INSEAD](#) recruitment procedure. Each participant received 10 euros as compensation. Data for both groups were collected in October 2021 and November 2021 in Paris. We excluded two participants from the non-musician group – one because of data collection problems and another one because of difficulties in understanding and performing the task.

### 2.2. Stimuli

To assess whether contrasts of register favor the identification of the music's humorous content, we needed to find pieces that were: 1. Overtly composed with a humorous intention in mind; 2. Relatively unknown, as to avoid recognition or contextual associations; 3. Not obviously laughter-inducing as our goal was to focus on the ability to identify a humorous intention, over and beyond the monitoring of one's own laughter reaction. A potential difficulty was to end up

cherry-picking such pieces. Our strategy was to focus on one composer, whose output would satisfy all three constraints, and then to select our excerpts from that composer's output in a very systematic fashion.

We thus chose to focus on French composer Cécile Chaminade (1857-1944), who wrote a series of humorous pieces that are typical of the early 20<sup>th</sup> century salon music. We considered only her piano pieces, so that our excerpts would not differ from one another in terms of timbre. We first identified all the piano pieces which contained in their title words or names associated with humor or comedy. We found 8 such pieces (*Humoresque*, *Étude humoristique*, *Caprice humoristique*, *Valse humoristique*, *Scaramouche*, *Pierrette*, *Arlequine*, *Caprice-impromptu*). We then looked within each of those pieces for contrasts of register. To count as a contrast in register, a passage would have to display at least two successive musical elements (a motive, a phrase) that were written in different registers (e.g., element A in the medium register, followed by element B in the higher register). Following those guidelines, we found 10 musical excerpts (of roughly 10-second length) build around a contrast in register. Those 10 musical excerpts belonged to 5 different pieces.

Each excerpt was then modified in the following ways:

- Inhibition towards the higher register: the contrast within the excerpt is eliminated by transposing one or two octaves higher (depending on the range of the original contrast) the element originally played in the lower register.
- Inhibition towards the lower register: the contrast within the excerpt is eliminated by transposing one or two octaves (depending on the range of the original contrast) lower the element originally played in the higher register.
- Augmentation towards the higher register: the contrast within the excerpt is increased by transposing one octave higher the element originally played in the higher register.
- Augmentation towards the lower register: the contrast within the excerpt is increased by transposing one octave lower the element originally played in the low register.

All these modifications were implemented using the MuseScore software. Sound files corresponding to each excerpt were then exported using the same software. This yielded a total of 50 sound excerpts: one original version and four modified versions for each of our initial musical passages. Figure 1 shows the score for one of the original excerpts by Cécile Chaminade (an excerpt from the *Étude humoristique*), together with its four modified versions. We also selected 15 additional excerpts, taken from the same corpus of “humorous” pieces, to act as distractors for our experiment.

## Étude humoristique op. 138

Cécile Chaminade (1857-1944)

Original version (b. 17-24)



Inhibition of the contrast towards the high register



Inhibition of the contrast towards the low register



Augmentation of the contrast towards the high register



Augmentation of the contrast towards the low register



Figure 1. Cécile Chaminade, *Étude Humoristique*, b. 17-24: original version and the four modified versions.

### 2.3. Procedure

We presented the 50 excerpts and the 15 additional distractors to participants, in two successive blocks. In the ‘emotion block’, participants had to listen to each excerpt and rate, on a continuous scale, the extent to which they found the music expressed something joyful (from “Not at all” to “Very much”). In the ‘humor block’, participants had to listen to each excerpt and rate, on a continuous scale, the extent to which they felt the music expressed something comical (from “Not at all” to “Very much”). The order of the two blocks was counterbalanced between participants. In each block, the order of the stimuli was pseudo-randomized by maximizing the distance between the different versions of the same musical passage (i.e., original, inhibited towards the high register, inhibited towards the low register, augmented

towards the high register, augmented towards the low register). The 15 distractor excerpts were randomly inserted within each blocks of stimuli to control for demand effects.

Finally, at the end of the experiment, participants had to answer the following four questions (presented in randomized order) on a continuous scale:

- To which extent did you imagine a scene (a movie scene, a theater scene, a scene from everyday life, etc.) to evaluate the comical content of musical excerpts? (from “Never” to “Always”)
- To which extent did you imagine a scene (a movie scene, a theater scene, a scene from everyday life, etc.) to evaluate the joyful content of musical excerpts? (from “Never” to “Always”)
- To which extent did you rely on your felt emotion while listening to evaluate the comical content of musical excerpts? (from “Never” to “Always”)
- To which extent did you rely on your felt emotion while listening to evaluate the joyful content of musical excerpts? (from “Never” to “Always”)

Note that, in our task, we chose to use the word “comical” (*comique* in French) rather than the word “humorous” (*humour* in French) for two reasons. First, in folk-terminologies as well as in humor research, the terms commonly used to describe humorous phenomena are notoriously numerous, ambiguous, mutually exclusive and even varying across languages and historical contexts (Attardo, 2020). In order to target as precisely as possible the idea of humor-as-content, we thus needed a term as less ambiguous as possible. In French, the word “comical” is less ambiguous than the word “humor”. The latter is an umbrella term (as pointed by Attardo, 2020: 7-10) used to denote any phenomenon related to the general category of humor. As such, it can be used to denote either a content with humorous properties or a stimulus that provokes laughter. On the opposite, the former is most often used to denote contents with humorous properties. Second, the word “comical” in French is more often associated with works of art (e.g., comedy in theatre, comedy movies, etc.) than the word “humorous”, making the question asked in our musical task more intuitive for the participants. However, we clearly take listeners’ ratings of what is labelled, in our task, “the comical content” to be adequately representative of the music’s humorous content in general. As such, in the following, we will always use the term “humorous” rather than “comical”, except when explicitly referring to the question that was asked to the participants.

#### 2.4. Statistical analysis

Our experiment follows a 2x2x2 design, with factors “Contrast” (Inhibition, Augmentation), “Register” (Higher, Lower) and “Musicianship” (Musician, Non-musician). We tested for main effects of Contrast and Register as well as their interaction using General Linear Mixed Models (GLMMs) in both groups of musicians and non-musicians. To test for main effects, we compared models with and without the fixed effect of interest. To test for interactions, we compared models including fixed effects versus models including fixed effects and their interaction. To control for interindividual and inter-excerpt variability, we plotted mean-normalized participants’ ratings by subtracting the mean rating given to the five different versions of an excerpt for each participant and each task. However, because we used participant number as a random factor in the GLMM analyses, we used non-transformed ratings for statistical analyses.

Finally, we analyzed the rating differences for the four debriefing questions with paired t-tests.



### 3. Results

#### 3.1. Contrasts of register impact the perception of musical humor

First, we examined the effect of Contrast on the perception of the excerpts' humorous and joyful content for both musicians and non-musicians (Figure 2). As predicted, analyses revealed that excerpts with an augmented contrast were judged as expressing significantly more humorous content both for musicians ( $\chi^2(1)= 5.9$ ,  $p=0.01$ ) and non-musicians ( $\chi^2(1)= 4.47$ ,  $p=0.03$ , figure 2-a).

Moreover, excerpts with an augmented contrast were judged as expressing marginally more joy than excerpts with an inhibited contrast for non-musicians ( $\chi^2(1)= 2.9$ ,  $p=0.08$ ) but not for musicians ( $\chi^2(1)= 0.30$ ,  $p=0.57$ , Figure 2-b). Besides being only marginally significant, the effect of Contrast in the Emotion task for non-musicians was also in the opposite direction than the one it had in the Humor task, meaning that excerpts with augmented contrasts were evaluated as less joyful than excerpts with inhibited contrasts. Taken together, these results are thus in line with our hypothesis of contrasts of register playing a privileged role in the identification of the music's humorous content.

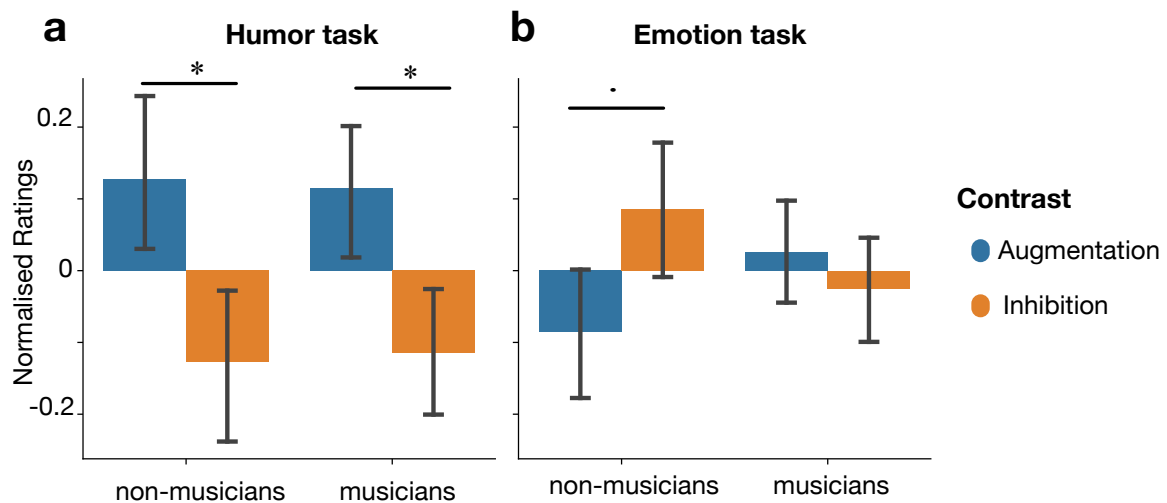


Figure 2. Effects of Contrasts on listeners' ratings for both humorous content and joyful content.

#### 3.2. Register impacts the perception of musical humor

Second, we found an effect of Register (i.e., an effect of whether the experimental manipulation involved a transposition towards a higher register or towards a lower register) on both the evaluation of the joyful content (musicians :  $\chi^2(1)= 34$ ,  $p= 5.24e-9$ ; non-musicians:  $\chi^2(1)=43.7$ ,  $p= 3.7e-11$ ; Figure 3-a) and on the evaluation of the humorous content of the excerpts (musicians :  $\chi^2(1)=16.4$ ,  $p= 4.998e-05$ ; non-musicians:  $\chi^2(1)= 13.3$ ,  $p=0.0002$ ; Figure 3-b). The effect was identical for the two groups of participants (see Figure 3). However, although Register impacted both humor and joy ratings, it had a stronger impact on joy ratings.

The effect of Register in the Emotion task is in line with many findings from music emotion studies, which have shown a consistent link between pitch frequency and emotional valence (for a recent overview, see Juslin, 2019). As for the effect of Register in the Humor task, it suggests that pitch frequencies are also relevant in the evaluation of the music's humorous content, and that musical passages displaying higher frequencies are more likely to be assessed as expressing humor.

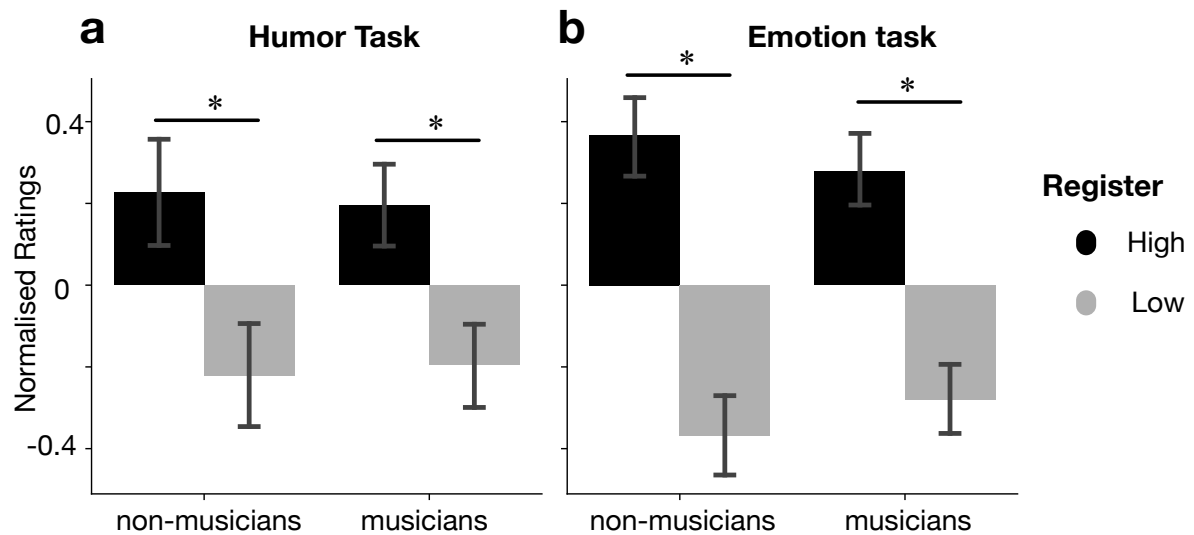


Figure 3. Effects of Register on listeners' ratings for both humorous content and joyful content.

### 3.3. Interactions between Contrast and Register in the perception of musical humor

For non-musicians, we did not find a significant interaction between Contrast and Register neither for the humor task ( $\chi^2(1) = 0.51$ ,  $p = 0.47$ ) nor for the emotion task ( $\chi^2(1) = 2.01$ ,  $p = 0.15$ ). For musicians, we found a significant interaction between Contrast and Register in the emotion task ( $\chi^2(1) = 7.0$ ,  $p = 0.007$ ), but no significant interaction in the humor task ( $\chi^2(1) = 2.47$ ,  $p = 0.11$ ).

However, because humor ratings were influenced by both Contrast and Register, we decided to further investigate the extent to which Contrast manipulations were independent of Register manipulations through post-hoc exploratory analyses (see Figure 4). Such analyses comparing contrast conditions across registers revealed that, for both musicians and non-musicians, the Contrast manipulation only significantly affected humor judgements when it involved a transposition towards a lower register ( $t(31) < 2.3$ ,  $p < 0.05$ , Figure 4-a, Figure 4-c). Inhibiting the contrast towards a lower register indeed involved eliminating the higher frequencies that were present in the original excerpt, while augmenting the contrast towards a lower register did not involve such elimination (cf. Figure 1 for an example). In other words, the absence of higher frequencies made it less likely for the excerpts to be evaluated as expressing something humorous, and thus seems to play a detrimental role in the perception of musical humor.

In the Emotion task, Contrast significantly affected non-musicians' joy judgements only when it involved a transposition towards a higher register ( $t(31) = -2.4$ ,  $p = 0.02$ , Figure 4-b), whereas it significantly affected musicians' joy judgements only when it involved a transposition towards a lower register ( $t(32) = 2.4$ ,  $p = 0.01$ , Figure 4-d). Again, these results are not surprising in light of music emotion studies: excerpts that had been deprived of their higher frequencies through our experimental manipulation were judged as less joyful by musicians, while, for non-musicians, it was the excerpts that had been deprived of their lower frequencies that were judged as more joyful. However, understanding exactly why non-musicians were more sensitive to the lack of low frequencies and musicians to the lack of high frequencies in the perception of musical joy would require further studies, controlling in particular for hearing sensitivity.

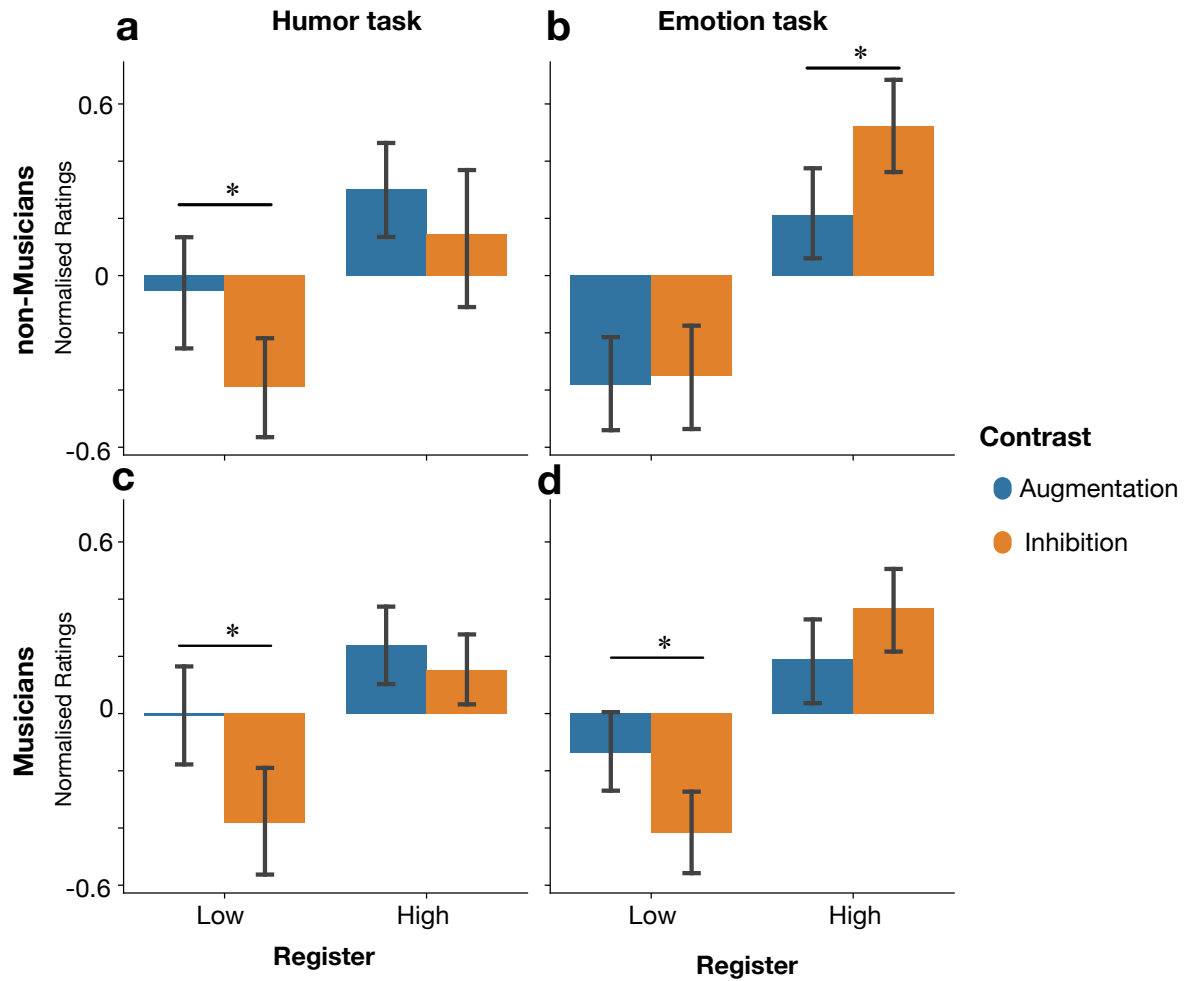


Figure 4. Interactions between Contrasts and Register.

These post-hoc analyses point towards the possibility that our two factors have no independent effects and/or that the perception of the music's humorous content is in fact mediated by the perception of its joyful content. However, our analyses provide a statistical control for the former explanation. Indeed, GLMM analyses compare models with and without fixed effects of interest, while integrating all other significant predictors. That is, the model containing both Contrast and Register is significantly better than the one containing only Register. Thus, even if Contrast and Register are in fact interacting in both our tasks (which is only shown through post-hoc analyses that would need to be confirmed in further experiments), Contrast still have an independent effect in the perception of humor. Regarding the latter, listeners' ratings of the music's humorous content and of its joyful content were indeed significantly correlated, albeit the strength of the correlation was weak ( $r=0.28$ ,  $p=0.04$ ; Figure 5). In other words, while there is clearly some relation between the perception of humor and the perception of joy in music, which may explain why the factors driving the perception of joy (such as higher pitch frequencies) also affect the perception of humor, the two properties are still independent to some extent, as testified by the fact that they were differently affected by our manipulation of contrasts of register.

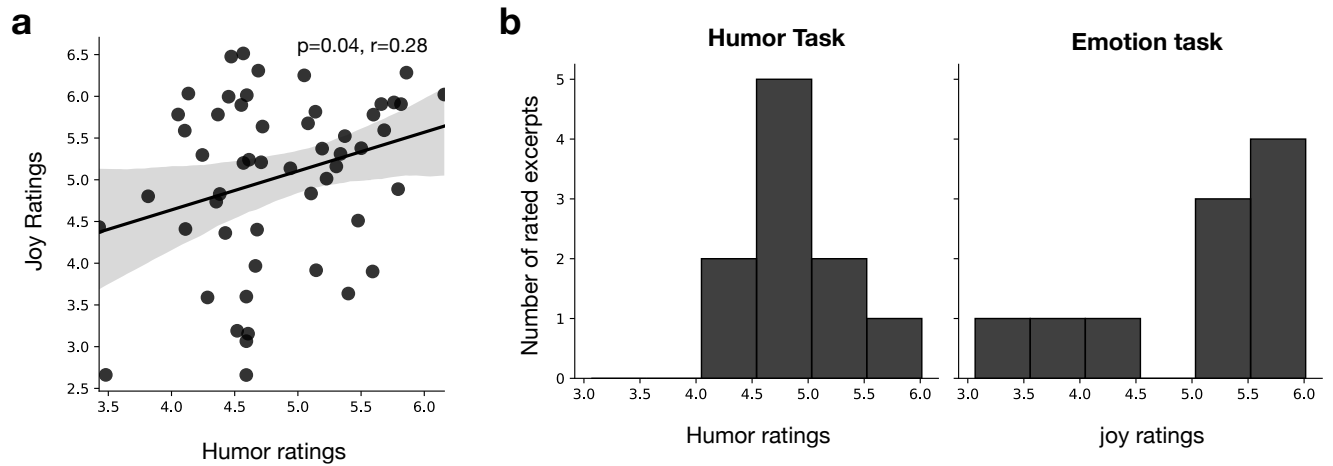


Figure 5. (A) Correlation between ratings of humorous content and ratings of joyful content. (B) Humor (left) and joy (right) ratings for original (non-manipulated) excerpts only.

### 3.4. Participants relied more on their imagination when they had to assess the music's humorous content

Finally, as shown in Figure 6, we found that participants were more likely to imagine a fictional scene while listening to music when they had to assess the music's humorous content, as compared as to when they had to assess the music's joyful content (musicians:  $t(30)=2.6$ ,  $p=0.01$ ; non-musicians:  $t(28)=2.24$ ,  $p=0.03$ ). However, no difference between the tasks was observed with respect to the extent to which the listeners relied on their felt emotions (musicians:  $t(30)=-0.320$ ,  $p=0.74$ ; non-musicians:  $t(28)=-1.48$ ,  $p=0.14$ ).

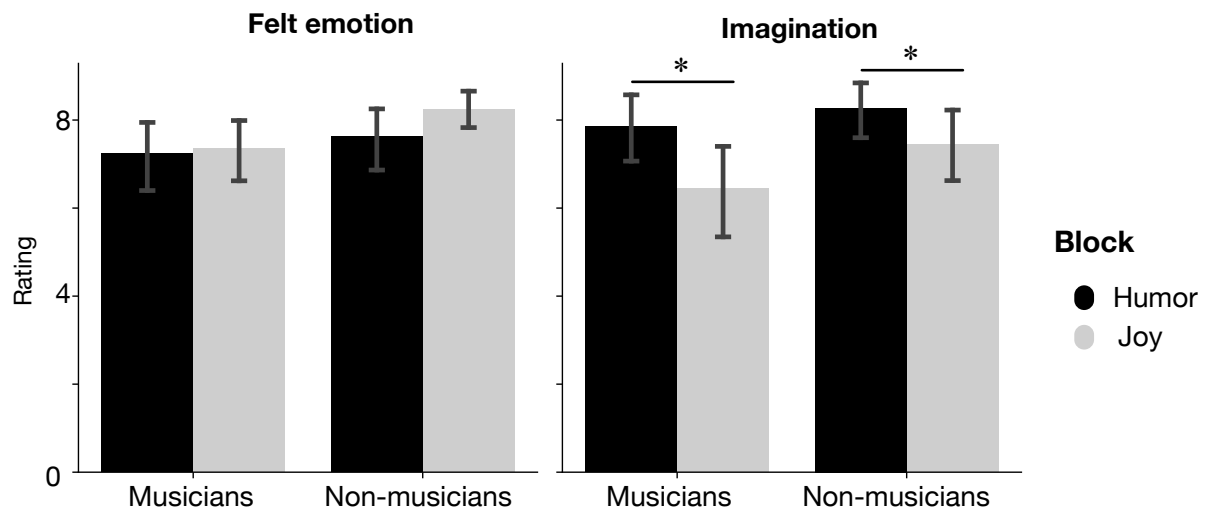


Figure 6. Reported listening strategies for the two rating tasks.

Here, it might be that, because of the style of the musical excerpts we selected, listeners spontaneously associated our stimuli with the music often taken (albeit generally falsely, see Altman, 2004) to accompany silent movies such as Chaplin's and that this association was made more salient when we asked them to evaluate the music's humorous content. It might also be that types of musical contents in fact differ in their immediacy – with basic emotions, such as joy, more immediately available to the listener's perception and more complex, layered contents, such as humor, requiring an additional act of imagination (Levinson, 1996). Lastly, this result could also be tied to the social nature of comedy – assessing the humorous content

of a musical passage implicitly triggering the need to imagine a social scene between interacting agents. We come back to this possibility in the discussion below.

#### 4. Discussion

Humor is present within all cultural and artistic medium, and music is of course no exception. Even when music has no accompanying vocals, musicians sometimes aim at giving some humorous undertones to their sonic output – as attested by the long list of musical genres which are more or less explicitly associated with humor, wit, or comedy. We believe that such musical presentations “under the humorous mode” – which are likely to be much more common than music aiming at eliciting full-fledged laughter – have not received the attention they deserve in empirical studies on musical humor. Despite being limited to the compositional output of one single composer, our study provides a first step in showing how simple, standard musical resources – such as contrasts of register – might underpin the expression of musical humor. Here, we showed that directly manipulating contrasts of register found in passages of Cécile Chaminade’s piano music impacted the extent to which listeners rated such passages as expressing something humorous. In particular, we showed that excerpts with an augmented contrast were judged as expressing significantly more humorous content than excerpts with an inhibited contrast.

A striking result of our study is that both expert and non-expert listeners’ ratings were mostly impacted in the same way by our manipulations of contrasts of register. It could be that all listeners are in fact similarly “experienced” when it comes to identify music’s expressive properties, as long as such listeners are sufficiently attuned, through mere exposition, to the broad sonic and syntactical properties of the musical culture under consideration (Bigand & Poulin-Charronnat, 2006). In this perspective, our results are compatible with the idea that hearing humor in music is not necessarily sophisticated or incredibly *recherché* – and that this kind of expressive or semantic property of musical excerpts might be readily accessible to a wide range of listeners. Another plausible explanation might be that the perception of musical humor taps in more general cognitive processes, independent of the musical medium. In particular, it might be that, because of the discontinuity introduced in the melodic flux, heightened contrasts of register were simply treated as the kind of benign violation that is typically associated with humor (Warren & MacGraw, 2015). We come back to this possibility below.

Four other aspects of our results related to the perception of musical humor deserve further discussion. First, our results show that the manipulation of the sole contrasts of register only had a limited impact on participants’ ratings. The musical expression of humor is indeed likely to be associated with the combination of different kinds of contrasts. For example, in the excerpt of the *Étude Humoristique* given above (see Figure 1), Chaminade doubles the contrast of register with a contrast of density (two or three parallel lines vs one single line) and a contrast of articulation (*marcato* vs *ordinario*), thus reinforcing the impression of hearing two different musical sources or persona, differing in size or weight, following one another on the auditory stage, or interacting in some way with one another (Bregman, 1990; Schlenker, 2017). In other words, contrasts of register tend not to be used in isolation but most often together with contrasts happening at some other levels, in order to achieve a clearer contrast in the overall gestalt of the musical piece. As such, it is not surprising that manipulating independently one specific kind of contrast only resulted in a somewhat small effect size. Further studies could explore more systematically the role of other types of contrasts and of their interactions in the expression of musical humor.

Second, the limited impact of contrasts of register in the perception of musical humor also points towards the idea that contrasts of register do not by themselves ground the music’s humorous content but rather function as a basic inferential parameter, making the inference of

a compositional humorous intent more relevant only when some other sonic conditions are met. Our original excerpts were indeed different in terms of modes, tempo, articulation, etc. As such, and independently of our manipulation, they presented some variability in how listeners found them expressing something humorous (see Figure 5-b). It is thus possible that contrasts of register were treated as cues that made the humorous intent more salient only in the appropriate sonic context – i.e., in the kind of context in which the interpretation of the music as expressing something humorous already made sense. In that perspective, contrasts of register would have a primarily pragmatic role, helping listeners to disambiguate between the various possible semantic interpretations afforded by the present musical context.

Third, and obviously, our results should not be interpreted as showing that contrasts of register invariably cause the music to be perceived as expressing something humorous. It would indeed be quite easy to exhibit a piece of music which display swift contrasts of register that are put to use for widely different expressive means than expressing humor. However, we saw that heightened contrasts of register did not led listeners to rate musical excerpts as more joyful – if anything, we rather observed that augmented contrasts made the music less likely to be perceived by non-expert listeners as expressing something joyful. In other words, if a passage of music expresses something joyful, augmenting the contrasts of register it contains does not seem to make it sounds more joyful. This rules out the possibility that contrasts of register act as a mere expressive intensifier, making more salient any basic expressive property of a given musical passage. Here, it might be useful to distinguish between basic expressive properties (such as sadness, joy, or anger), which are directly perceived within the music on the basis of some resemblance with the vocal expression of the corresponding emotion (Bedoya et al., 2021; Juslin, 2019) and more complex expressive properties, which require from the listener to engage in an additional act of imagination – imagining for example that a persona within the music is expressing such or such emotion or mental state (Levinson, 1996; Hatten, 2018). A possible explanation of our pattern of results would be that contrasts of register only make more salient this later kind of expressive properties, by making it easier for the listeners to hear the music as expressing some kind of abstract narrative or dramatic content (Almén, 2008). This is consistent with the fact that listeners tended to engage significantly more in acts of imagination when they had to assess the music's humorous content, as compared to its joyful content.

But again, this picture may need to be refined. Recent studies on narrative engagement with music (McAuley et al., 2021) indeed showed that inhibiting contrasts in musical excerpts did not in fact reduce the ability of listeners to engage in narratives when listening to such excerpts. So it cannot be that contrasts of register just make it generally easier for listeners to engage in acts of imagination when listening to music. Rather, it might be that contrasts of register are specifically important when some kind of *social* imagination is required – when the perception of the music's expressive content relies on the listener's ability to hear at least two different musical personae, or to hear a social interaction within the music (Aucouturier & Canonne, 2017). This is clearly not the case for every narrative one might imagine when hearing music; but this is likely to be a crucial aspect of being able to hear the humorous content of a piece of music, given the often-social nature of comedy. Such perspective would explain why contrasts of register impacted the perception of the music's humorous content in such a clear way. In that sense, the presence of augmented contrasts made it easier for our participants to imagine two different agents interacting in a fictional scene, akin to prototypical scenes of comedy duo, which are precisely build around uneven relationships between two characters (Roberts, 2018). Fourth, our results also show an impact of register on the perception of the music's humorous content. Here we found that listeners were less likely to rate the excerpts as expressing something humorous when parts of the excerpts had been transposed towards a lower register, resulting in the elimination of the excerpt's higher frequencies. Such result suggests that iconic or imitative resources might play a role in the perception of musical humor. In particular, a

musical piece could convey a humorous content because it imitates laughter, or because the listener recognizes in it a musical representation of the sonic phenomenon of laughter. For example, previous work by Trevor and Huron (2019) investigated whether isochronous staccato rhythmic patterns are more likely to be found in instrumental music associated with humor, but provided only mixed evidence that such compositions actually emulated the prototypical rhythmic pattern of laughter. But besides their rhythmic structure, laughter are also distinctive in terms of their fundamental frequency, which is routinely much higher than in speech (Bachorowski et al., 2001). Moreover, the fundamental frequency of laughter is also more likely to change swiftly over time, often from one extreme to the other. And it is precisely the excerpts in which the contrast had been augmented by transposing one motive in the upper register that were judged as most humorous. As such, our results are compatible with the idea that musical humor is more likely to be perceived when the music is heard as presenting some broad iconic resemblance with the sonic manifestation of laughter.

One way to systematize the four above interpretations of our results in a coherent way is to consider them as a set of hypotheses about the semantic and pragmatic functions of contrasts of register in the perception of the music's humorous content. The central point is that these possible functions of contrast of register in humorous music are not necessarily mutually exclusive, similarly to what can be observed in other aspects of music cognition like narrativity, in which contrasts of register have both semantic and pragmatic functions (MacAuley et al., 2021). Further comparative studies, including cross-cultural and cross-historical perspectives, should be conducted to refine our understanding of these semantic and pragmatic functions.

That being said, as fruitful as these four interpretations of our results are, they still leave open one important question: what are the underlying cognitive mechanisms enabling contrasts of register to have such semantic or pragmatic effects on the perception of the music's humorous content? Our results do not provide an answer to such question, but the very nature of the parameter we have chosen may provide one. Contrasts of register are indeed closely related to two of the main theories of humor, namely the incongruity theory and the play theory (Carroll, 2014; Attardo, 2020). They are likely to induce, on the one hand, surprise (i.e., incongruity) within the listener's expectations of the musical form, and, on the other hand, a sense of playfulness, given their tendency to activate the perception of a social interaction of humorous nature within the music (e.g., the two personae of a comical duo).

To draw on a now classic distinction in joke studies (Attardo, Hempelmann & Di Maio, 2002), contrasts of register could be considered as "background incongruities" – i.e., an incongruous content that is part of the fictional situation depicted by the joke rather than of the punchline of the joke. In other words, background incongruities can be seen as a kind of incongruous content that is not addressed or resolved but rather explicitly presented as a normal aspect of the scene. For example, in the joke "How does an elephant hide in a cherry tree? It paints its toenails red" (Hempelmann & Attardo, 2011: 132), the representation of an elephant hiding in a cherry tree is a background incongruity because it is presented as a presupposition of the question, i.e., as a (falsely) non-controversial matter of fact. Conversely, the representation of the same elephant painting its toenails in red is a "foreground incongruity", because it is presented as a surprising answer to the question – i.e., an incongruous content that plays the role of the punchline of the joke. Empirical studies have shown that background incongruities increase the processing and evaluation of the humorous content of jokes compared to jokes without background incongruities (Samson & Hempelmann, 2011; Attardo, 2020). Here, contrasts of register in music, as a normal syntactic parameter, could clearly be seen as playing the role of background incongruities when they are conveying a humorous content.

As for the link between contrasts of register and play theory, contrasts of register could here have the meta-communicative role of "keying" (Hymes, 1972) or "framing" (Goffman, 1974) the humorous nature of the musical content. In that perspective, contrasts of register are

perceived as a signal indicating a playful situation and/or context of interpretation, i.e., communicating a meta-message such as “this is play” or “activate a playful mindset” (Bateson, 1972). This potentially leads to a humorous interpretation of the musical content, given the correlation often observed between humor and playfulness, especially in music (Hevner, 1936; Moseley, 2016).

This functionalist description of both background incongruities (as a semantic type of incongruities within a fictional situation) and framing of a playful mode of interpretation (as a pragmatic function of the message communicating something about the message itself) offers a coherent explanation of the cognitive mechanisms which might underlie the role of contrasts of register in the perception of musical humor:

- Contrasts of register, considered as a specific kind of contrast to be combined with other kinds of contrasts, play the semantic role of background incongruities, enhancing the processing and evaluation of the humorous nature of the musical content.
- Contrasts of register, considered as a basic inferential parameter, have the pragmatic function of framing a supposedly intended playful mode of interpretation of the musical content.
- Contrasts of register, considered as an expressive intensifier of social-imaginative expressive properties, also play the semantic role of background incongruities, but in a more indirect way: complex expressive properties that are intensified and, at the same time, that involve social imagination, are more likely to be interpreted as exaggerated and/or stereotypical behaviors between at least two agents/personae, which is a typical background situation of a humorous content.
- Contrasts of register, considered as presenting some broad iconic resemblance with the sonic manifestation of laughter, also have a pragmatic function of framing a playful mode of interpretation of the musical content: iconic imitation of laughter within a non-obvious joking context, such as listening to classical music, are likely to be perceived as incongruous at a semantic level and, then, re-interpreted at a pragmatic level as signaling “This is play / This is humor”.

Ultimately, such an interpretation of contrasts of register as being at the interface between semantics and pragmatics invites us to reconsider the very divide between humor-as-experience and humor-as-content. Indeed, it remains a possibility that the music’s humorous content is in fact inferred by listeners on the basis of their felt experience; and conversely, it could be that some humorous experience is aroused in the listeners once she identifies the music’s humorous content, through emotional contagion or empathy (for a similar discussion on the case of musical emotions, see Levinson, 1996; Song et al., 2016). These possibilities could be empirically investigated, for example by comparing participants’ zygomatic activity (the muscle used to smile) before and after the introduction of a contrast of register in a musical stimulus – as done for the study of vocal emotions (Arias et al., 2018). If bursting into laughter is an uncommon reaction to music, as David Huron once claimed, we would argue that smiling is not. Such a move from laughter to smiling would allow to study in a more fine-grained fashion the relation between the semantics of musical humor and listeners’ physiological and psychological experience, thus helping bridging the gap between two lines of research that has remained separated for too long.



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