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Birth of the cool: a two-centuries decline in emotional expression in Anglophone fiction

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ABSTRACT

The presence of emotional words and content in stories has been shown to enhance a story's memorability, and its cultural success. Yet, recent cultural trends run in the opposite direction. Using the Google Books corpus, coupled with two metadata-rich corpora of Anglophone fiction books, we show a decrease in emotionality in English-speaking literature starting plausibly in the nineteenth century. We show that this decrease cannot be explained by changes unrelated to emotionality (such as demographic dynamics concerning age or gender balance, changes in vocabulary richness, or changes in the prevalence of literary genres), and that, in our three corpora, the decrease is driven almost entirely by a decline in the proportion of *positive* emotion-related words, while the frequency of *negative* emotion-related words shows little if any decline. Consistently with previous studies, we also find a link between ageing and negative emotionality at the individual level.

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The availability of massive data sets, in digital form, opens unprecedented possibilities for cultural trends analysis. Long-term cultural trends, in turn, offer a window on human psychology. Having passed through long transmission chains from one individual to another, they should bear the mark of all these minds' proclivities and biases. Researchers in the field of cultural evolution posit that cultural transmission is more likely to maintain stories with emotional content, a prediction largely confirmed both by experimental and by observational data (Eriksson & Coultas, 2014; Eriksson, Coultas, & de Barra, 2016; Heath, Bell, & Sternberg, 2001; Stubbsfield, Tehrani, & Flynn, *in press*). Emotional words are thought to enhance memorability (Doerksen & Shimamura, 2001; Kensinger & Corkin, 2003; Levine & Pizarro, 2004; Talmi & Moscovitch, 2004). This is especially true of positively valenced words (Ferré, 2003). By a similar logic, the features of the English language that make

words more memorable have increased in the last 200 years (Hills & Adelman, 2015). Emotionality should be no exception.

Contrary to these expectations, Acerbi et al. (Acerbi, Lampos, & Bentley, 2014; Acerbi, Lampos, Garnett, & Bentley, 2013) found a steady decrease, throughout the twentieth century, in the presence of emotion-related words in the English-language printed literature sampled in the Google Books corpus (Michel et al., 2010). Martindale (1990) discovered a similar trend towards reduced emotionality in the work of French and American poets who wrote from the early nineteenth to the twentieth century (Martindale, 1990, pp. 98–99, 163–165).

The opportunity of drawing robust inferences from trends identified in the Google Books corpus, however, has been recently questioned. The main criticism is related to the lack of metadata (Koplenig, 2015): we do not know what the corpus exactly

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contains. Particularly worrying for the validity of the emotionality decline is the parallel increase in the sampling of technical and scientific literature in the corpus (Pechenick, Danforth, & Dodds, 2015). In this perspective, the decreasing presence of emotion-related terms might not reflect any real literary, linguistic, or cultural, trend, but simply a change in the composition of the corpus through the years.

Additionally, the lack of metadata does not help us in understanding the underlying causes of the apparent decline of emotional vocabulary. Some might be demographic: age and gender are known to modulate emotional expression (Pennebaker & Stone, 2003). Others might be more linguistic in nature: if emotional words are relatively common, an increase in vocabulary size at book level (for example) could explain their relative decrease.

In this paper, we attempt to provide a better grounding for the hypothesis that the decreasing in emotion-related words is a real linguistic and cultural phenomenon, and to contextualise it in a wider cognitive and cultural framework. First, we ran a new analysis on the Google Books corpus, focusing on the English Fiction sample from the second version (2012) of the corpus, in which the influx of the increase of technical literature seems to be absent or strongly limited (Pechenick et al., 2015). Second, we replicated this analysis on two “small data” corpora: collections of books that we built ourselves, and for which we have all the relevant metadata needed to control for a variety of factors (the author’s age, gender, and vocabulary size, to cite the most important).

We report four main findings. (i) Our data confirm that the decrease in emotionality in English-speaking literature is no artefact of the Google Books corpus, and that it pre-dates the twentieth century, plausibly beginning in the early nineteenth century; (ii) this general decline cannot be explained by changes unrelated to emotionality (such as demographic dynamics concerning age or gender balance, changes in vocabulary richness, or changes in the prevalence of literary genres); (iii) in our three corpora, this decrease in the proportion of emotion-related words in literary texts is driven almost entirely by a decline in the proportion of *positive* emotion-related words, while the frequency of *negative* emotion-related words shows little decline (if any), and (iv) author’s age, consistently with previous studies (Pennebaker & Stone, 2003), covaries with negative emotionality, with older authors using proportionally fewer negative emotion-related words.

In the discussion, we consider several possible explanations for the birth of a “cool”, detached emotional style that avoids positive emotional expression. A dynamic of “regression to the mean” following the domination, in the late eighteenth and early nineteenth century, of the exuberant Romantic style, is one possibility. Overall, we take our work as showing the importance of the combined use of “big data” (abundant, but lacking in metadata, datasets) and “small” data (datasets more restricted, but metadata-rich) to investigate cultural changes. In addition, our results suggest that the “Pollyanna effect” (the predominance of positively valenced words over negatively valenced ones – (Boucher & Osgood, 1969; Kloumann, Danforth, Harris, Bliss, & Dodds, 2012) may not be an invariant feature of language, but is subject to historical fluctuations.

Methods

Google books corpus analysis

We extracted the frequency of emotion-related words from the English fiction data set of the second version (version 20120701) of the Google Books corpus (available online at: <http://storage.googleapis.com/books/ngrams/books/datasetsv2.html>). We limited our analysis to years between 1900 and 2000, both included, as the number of books present in the sample before the beginning of twentieth century is substantially lower, and recent books, published after 2000, are still being included in the corpus. This made for more than three hundred thousand volumes (307,527) considered in our analysis over 101 consecutive years.

Emotion-related terms were processed using “Linguistic inquiry and word count” (LIWC) (Pennebaker, Chung, Ireland, Gonzales, & Booth, 2007). The LIWC consists in a number of taxonomies of semantically affine words, evaluated by human judges, and is a standard tool in text mining (Kahn, Tobin, Massey, & Anderson, 2007; Schwartz et al., 2013; Tov, Ng, Lin, & Qiu, 2013). We used the taxonomies of “Positive Emotions” and “Negative Emotions”, consisting respectively of 408 and 499 terms. Such taxonomies include both stemmed (e.g. in the “Negative Emotions” taxonomy: *abandon**, *victim**, which will retrieve *abandoned*, *abandonment*, *victim*, *victimisation*, etc.) and complete (non-stemmed) terms (such as *agony* or *vile*). We first collected, for each year, the total number of case-insensitive occurrences of all terms in the taxonomies. We then normalised it with

the total number of 1-grams present in the sample for each year, and finally summed the frequencies to have a general indicator of the emotion-related words usage trends.

“Small data” analysis

To assess the validity of the results extracted from the Google Books corpus, we used the same methodology to analyse two corpora of books, smaller than the Google Books corpus, but for which we have all the metadata we need – “small data” corpora.

The first corpus (corpus A), which compares with the early or pre-twentieth century Google Books sample, is constituted by British classic writers. This corpus included all the British authors who satisfied two conditions: (i) being mentioned in Altick’s list of nineteenth century English bestsellers (1969, 1986) that includes authors born between the seventeenth and nineteenth century, whose work sold very well in the nineteenth and early twentieth centuries, and (ii) being extensively covered in the English language version of Wikipedia (<https://en.wikipedia.org> - at least one complete novel summarised). For each author, all the novels whose complete text was available in the Gutenberg online library (<https://www.gutenberg.org>) were included. The Wikipedia and Gutenberg searches were conducted in December 2013. The corpus contains 200 volumes from 22 different authors, ranging from 1696 to 1923, with the median in 1848 (81% having been published after 1800).

The second corpus (corpus B) consisted in 437 free-access English-language books. Four hundred and ninety-eight books were taken from the Gutenberg project’s website (<https://www.gutenberg.org>, consulted December 2015), representing all the books found at that time whose author had a name starting with an -L or an -R (two randomly selected letters). Among those, we kept only datable books that had one identifiable English-speaking author. Overall, 61 books were excluded: 15 because they could not be dated, 20 because they were translations, 25 that had multiple authors, and 1 that could not be attributed. Four hundred and twenty-eight books by 228 different authors remained, ranging from 1725 to 1943, with the median in 1909 (72% of these books were published in the twentieth century). Corpus B is completely independent from corpus A (no book is present in both).

The combined frequency of positive and negative emotions (as defined for the Google Books corpus, see above) was calculated for the 200 books in

corpus A and the 437 books in corpus B. Data were collected on seven other variables: the author’s gender (GENDER) and birthdate (BIRTH), the book’s date (DATE), the author’s age (AGE), the book’s length in words (LENGTH), and the book’s level of vocabulary richness (VOCABULARY), obtained as the number of word types used in the book divided by the number of word tokens in the book. Since corpus 2 contained many non-fiction works, we used a FICTION variable for that corpus (but not for corpus A, which comprised a wide majority of novels). Full data for corpora A and B can be downloaded on: <http://osf.io/qz89v/>.

Results

Emotionality declines with time in all three corpora

The total frequency of emotion-related terms, calculated as the sum of “Positive Emotions” and “Negative Emotions” taxonomies in LIWC, steadily decreases in the English language fiction sample of the Google Books Corpus (Figure 1; $r_s = -0.86$, $p < .0001$, $N = 101$ years, Spearman correlation).

An analogous effect was found in the “small data” corpora. As a first step, a series of nested models was built to predict EMOTIONALITY: the null model, and all possible combinations of the GENDER, VOCABULARY, LENGTH, and AGE variables. Since we wanted to know the effect of DATE in both corpora, we included that

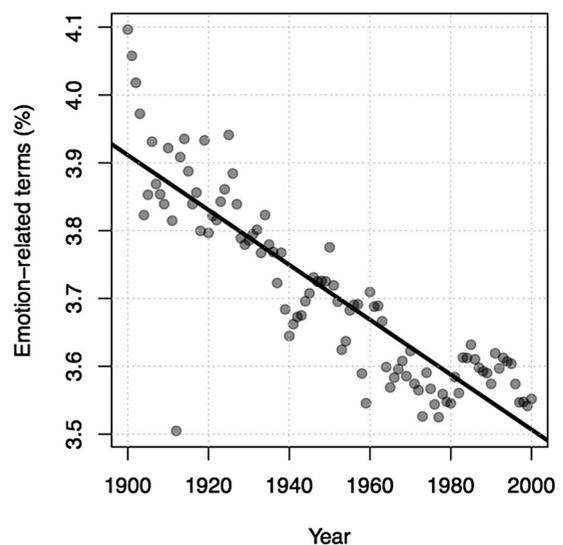


Figure 1. Emotionality changes in Anglophone literature, for the Google Books corpus. The solid line represents a linear regression of the data.

Table 1. Predictors of emotionality: fixed effects estimates for Models 2a (Corpus A) and 2b (Corpus B).

Parameter	Estimate	Std error	Degrees of freedom	<i>t</i>	Sig.	95% C.I.	
						Lower	Higher
Model 2a							
Intercept	.176183	.027450	20.248	6.418	.000	.118968	.233397
Gender (M instead of <i>F</i>)	−.008387	.002147	18.593	−3.906	.001	−.012888	−.003886
Age	−.000027	.000036	167.452	−.753	.452	−.000099	.000044
Date	−.000068	.000015	19.539	−4.467	.000	−.000099	−.000036
Model 2b							
Intercept	.175386	.024524	418.337	7.152	.000	.127181	.223592
Gender (M instead of <i>F</i>)	−.003	.000827	211.207	−3.628	.000	−.004630	.001370
Length (z-score)	.000637	.000250	397.562	2.551	.011	.000146	.001128
Date	−.00007	.000013	418.379	−5.457	.000	−.000096	−.000045

variable to our best model for each: we took the model that minimised Akaike's Information Criterion (AIC) (see Supplementary materials 1, Table SM1.1) and added the DATE variable to that model. For both corpora, the resulting model also had the lowest AIC of all. Here (and in all other analyses of emotion expression in this paper), most of the variance is among authors rather than inside them (intra-class correlation: 0.61 for Corpus A, 0.79 for Corpus B).

Our two models with the lowest AIC (2a for corpus A, 2b for corpus B – see Table 1) both include a book's date as a predictor of its use of emotional vocabulary. For both, the estimates of the fixed effects indicate a decrease of emotionality through time. Our estimate for the rate of change in the two corpora is almost identical: a decrease of around 0.007% per year (or 0.7% per century). Given the average frequency of emotional words (a grand mean of 4.5% in corpus A, 3.9% in corpus B) this represents a substantial decrease (Figure 2). The rate of decrease is smaller in the Google Books sample (which showed a loss of 0.4% over the century), but the order of magnitude is the same.

The decrease cannot be explained by changes unrelated to emotionality

Both models show the emotionality decline to be independent of any change in the GENDER composition of the population of writers through time. Our best model for corpus A also shows that the decline holds when controlling for AGE, while AGE is not informative enough to figure in our best model for corpus B. There was a small increase in the age of our corpora's authors (correlation between AGE and DATE: Spearman's $\rho = 0.16$ for both corpora, A and B), but it fails to explain the emotionality decline over time.

Neither of our best models for corpora A and B includes a book's VOCABULARY size. Incidentally, the average number of distinct word types present in books did not grow substantially over the time periods we studied (correlation between DATE and VOCABULARY: Spearman's $\rho = 0.10$ for corpus A, 0.05 for corpus B), and we can thus rule this out as an explanation for the decline in emotionality. Another variable – whether a book was a work of FICTION or not –, fails to predict emotionality for the only corpus where it was relevant (corpus B).

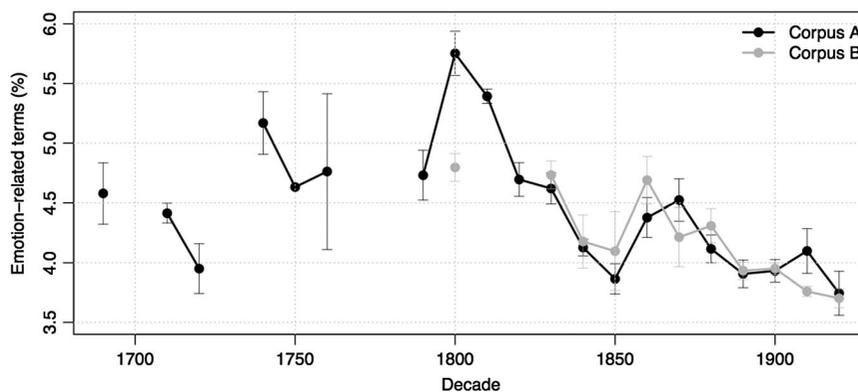
**Figure 2.** Emotionality changes in Anglophone literature, for the two “small data” corpora. Error bars represent 95% confidence intervals.

Table 2. Predictors of positive emotionality: fixed effects estimates for Models 7a (corpus A) and 7b (corpus B).

Parameter	Estimate	Std error	Degrees of freedom	<i>t</i>	Sig.	95% C.I.	
						Lower	Higher
Model 7a							
Intercept	.126810	.023981	335.676	5.288	.000	.078158	.175462
Gender (M instead of F)	-.006048	.002016	20.590	-3.001	.007	-.010245	-.001852
Date	-.000051	.000013	35.514	-3.929	.000	-.000078	-.000025
Model 7b							
Intercept	.141938	.019624	427.504	7.233	.000	.103365	.180510
Gender (M instead of F)	-.003061	.000672	214.690	-4.558	.000	-.004385	-.001737
Length (z-score)	.000394	.000198	398.428	1.989	.047	.000005	.0000783
Date	-.00006	.000010	427.554	-4.234	.000	-.000081	-.000040

Positive emotionality drives the decline, in all three corpora

Our “big data” corpus shows no clear trend regarding negative emotions (Figure 3 (a); $r_s = 0.1$, $p = .32$, $n = 101$ Spearman correlation), but the LIWC analysis identifies a strong decreasing trend for positive emotion-related terms (Figure 3 (b); $r_s = -0.95$, $p < .0001$, $n = 101$, Spearman correlation).

Our Google Books results lead us to expect in the “small data” corpora a decrease in the frequency of words linked to positive emotions (POSITIVE EMOTIONALITY) that is roughly as strong as the overall decrease in emotionality. To test this prediction, we repeated our analysis of EMOTIONALITY, this time using our models to predict POSITIVE EMOTIONALITY. Here again, we took the best model of all the models combining GENDER, AGE, LENGTH, VOCABULARY, and (for corpus B) FICTION, then added the DATE variable to this best model. For

both corpora, the resulting model included GENDER, and had the lowest AIC of all (Supplementary materials 1, Table SM1.2).

The models (Models 7a and 7b in Table 2) reveal a strong decline of positive emotionality through time, in each corpus. The level of Emotionality drops by 0.5 (A) to 0.6 (B) percentage points per century, for a grand mean of 2.9% (A) to 2.5% (B). Proportionally, the trend is stronger than the overall decrease of EMOTIONALITY in both corpora. Again, the order of magnitude of these results is the same as the Google Books findings.

Two models (10a and 10b in Table SM1.3, Supplementary materials 1) were used to test whether the expression of negative emotions declined with time. These models added the date variable to the best model obtained from all other variables. For corpus A, adding the DATE variable to model 9a

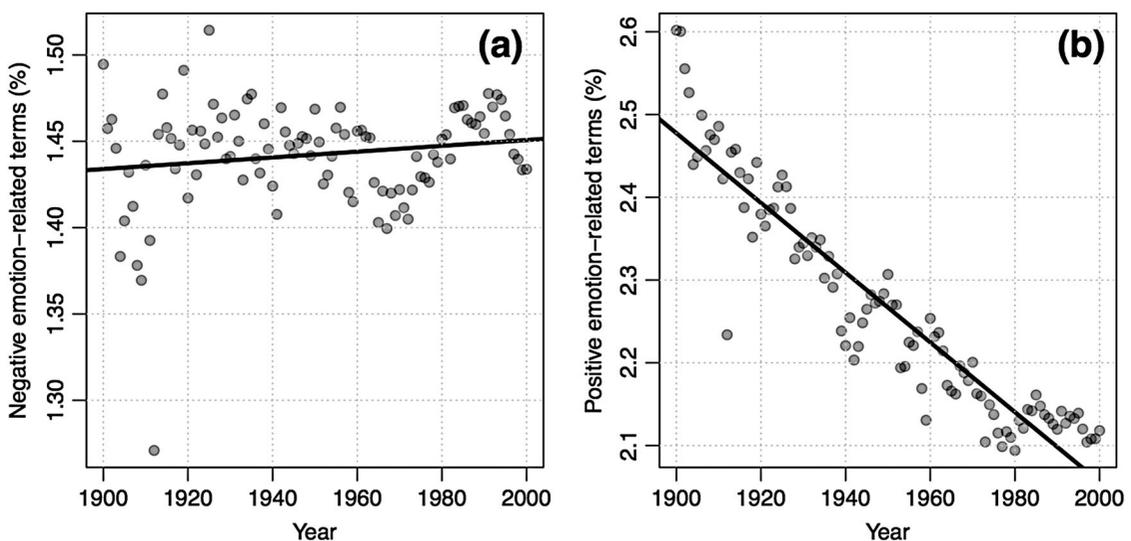


Figure 3. Emotionality changes in Anglophone literature, for the Google Books corpus. (a): negative emotions-related terms. (b): positive emotions-related terms. Solid lines represent linear regressions of the data.

Table 3. Predictors of negative emotionality: fixed effect estimates for Models 10a (corpus A) and 10b (corpus B).

Parameter	Estimate	Std error	Degrees of freedom	<i>t</i>	Sig.	95% C.I.	
						Lower	Higher
Model 10a							
Intercept	.045284	.013990	18.864	3.237	.004	.015988	.074579
Gender (M instead of F)	-.02228	.001098	17.112	-2.030	.058	-.000030	.000003
Age	-.000062	.000018	160.486	-3.530	.001	-.000097	-.000027
Date	-.000013	.000008	18.259	-1.743	.098	-.000030	.000003
Model 10b							
Intercept	.026614	.014290	376.766	1.862	.063	-.001484	.054712
Length	.000322	.000153	428.872	2.111	.035	.000022	.000623
Age	-.000017	.000009	303.929	-1.924	.055	-.000034	.000000
Date	-.000006	.000006	374.782	-.820	.413	-.000021	.000009

produces a more informative model (10a), which includes a weakly negative effect of chronological time. Adding the date variable to Model 9b produces a model (10b) that is less informative and includes a very weak effect of DATE (Table 3). Here again, we take this as a precise validation of the trends described by the Google Books data. The results are consistent with the Google Books data, showing that negative emotions do not decline as steeply as positive emotions do.

Negative emotions and ageing

Our best models for negative emotionality in both corpora, 9a and 9b, both include the AGE variable, and reveal a substantial negative effect of ageing on the expression of negative emotions. The trend is small, particularly in corpus B (a loss of 0.17 percentage point per century is small, if we consider that a writer's productive period rarely exceeds 40 years), which is consistent with Pennebaker & Stone's, 2003 estimate (a weak correlation of $-.120$ – Spearman's rho – between age and negative emotionality).

Discussion

Our analysis confirms the existence of a decline in the usage of words expressing emotions in the Anglophone literature. This decline possibly predated the twentieth century, and it was mainly driven by a decrease in the expression of positive emotions, while the expression of negative emotions remained more or less constant. Using metadata-rich “small data” corpora, we showed that this decline is not an artefact of the Google Books corpus sampling, and is independent of demographic changes in the population of writers, or of changes in the vocabulary richness or length of books.

Genre dynamics

Our data dispel the suspicion that the emotionality decline might be due to a recent flow of non-fiction material into the Google Books data: not only did we replicate Acerbi et al.'s, 2013 findings with the more recent fiction-only Google Books corpus, but we also found for the small-data corpus B that a book's belonging to the fiction or non-fiction genre is not a good predictor of its emotional content.

Additionally, we found evidence that changes in the kind of literature favoured by readers did not drive the emotionality decline. Different genres are known to influence emotional expression in precise and predictable ways (Nichols, Lynn, & Purzycki, 2014; Samothrakis & Fasli, 2015), and the periods covered by our three corpus were times of intense innovation that saw the rise of the Gothic novel, the pulp, science fiction, Westerns, to name but a few. Nonetheless, we are reluctant to explain the decline of positive emotionality on that basis. The decrease is similar in our corpus A, which includes the literary canon, and in our corpus B, composed of much more obscure and genre-following work (including many Western, adventure, and romance novels). The fact that the decline in emotionality manifests itself inside the work of individual authors (see below) also seems to argue against a genre-based view of the shift. We also note that the rise of detective novels and horror stories in the period we consider failed to bring about a substantial increase in negative emotional vocabulary.

Genre dynamics suggest another possible explanation. It could be that literature high in positive emotional content got channelled into some “underground” publication industry, much like stories of horror and violence were long confined to broadsheet ballads, then to penny dreadfuls, then to pulps. Yet we

cannot think of any underground industry that would have played the same part for positive emotions. Romance novels are well represented in our two small data corpora. Romance paperbacks, though distributed through alternative circuits for much of the twentieth century, are referenced in Google's database (which features, for example, Harlequin and Cartland).

Semantic changes

The LIWC lists of emotion words are built using ratings of contemporary human judges. Our analysis covers a span of two centuries for the "small data" corpora, and one century for the Google Books corpus: it is evident that, in this period of time, some of the words we track changed connotations. Some (like the adjective "fond") went from mainly negative connotations to mainly positive ones. Others underwent semantic "bleaching": a highly positive meaning gave way to weaker positive connotations. Words like "fine", "okay", or "gentle" are cases in point. Finally, others like "ROFL" did not exist a few years ago, so their impact on our study is minimal. Negative words underwent similar changes.

However, such semantic changes are unlikely to cause the trends we found. Suppose, for instance, that we make the (unlikely) assumption that our positive emotional words acquired their positive connotations only recently. This would not explain the decline in their use: on the contrary, their becoming positively connoted should make them more frequent (as per the Pollyanna effect, see below). Symmetrically, we could assume that the majority of our positive words have undergone semantic bleaching in the recent past. This could explain the decline in positive emotional expression, but only if we also make the unlikely assumption that positive words *as a group* became less intensely positive.

Age and emotional expression

One rationale for exploring demographic dynamics was that we hoped they might hold the key to the emotionality decline. The opposite is true: we do observe some effects of ageing on emotional expression, but these have nothing to do with its centuries-long decrease.

The claim that the expression of emotions decreases with increasing age has been mooted in some early papers (Labouvie-Vief, DeVoe, & Bulka,

1989; Lawton, Kleban, Rajagopal, & Dean, 1992; Mroczek, 2001), but it is no longer accepted. However, there is strong evidence for a decline in the expression of *negative* emotions as people age (Augustine, Mehl, & Larsen, 2011; Birditt, Fingerman, & Almeida, 2005; Gross et al., 1997; Löckenhoff, Costa, & Lane, 2008; Ready, Weinberger, & Jones, 2007; Ross & Mirowsky, 2008; Schieman, 1999). The view that older people are less attentive to the events that would induce negative emotions (or better able to control such emotions) may also receive some support from experimental work on verbal processing. Compared to younger age groups, older people appear to have difficulties processing emotional lexical terms, but these difficulties do not affect all emotions uniformly: the pattern is neat for anger, fear and sadness, while lexical processing and recall seem relatively preserved for disgust, happiness, and surprise (Isaacowitz et al., 2007). Reaction time data also show older people to process negative emotional words less fluently than positive emotional words, a pattern that is reversed in younger people (Lynchard & Radvansky, 2012). In these respects, older people's processing of emotional words resembles the way they process non-verbal stimuli: they experience more difficulties in identifying emotions, especially anger and sadness (Ruffman, Henry, Livingstone, & Phillips, 2008).

Our data provides some support for the view that ageing is linked to reduced expression of negative emotionality: we replicated the weak correlation found by Pennebaker and Stone (2003). On the other hand, none of the known age-related changes in emotional expression seem capable of explaining the historical pattern that we identify. Even though authors do become slightly older with time in our two "small data" corpora, all the changes in emotional expression documented here held when controlling for the effects of ageing. Finally, the shape of the decline (negative emotions staying flat while positive emotional expression decreases) is the very opposite of what it should be if it were an effect of authors ageing.

The emotionality decline might have other demographic causes besides ageing. It could be linked, for instance, with generational change – but here again our data rule this possibility out. In an analysis presented in Supplementary materials 2, we sought to check whether the emotionality decline resulted from a change *of* authors (the coming of new generations with a distinctive style) or a change *in* authors

(a change that affects the authors themselves independently of their generation). The result shows that time makes all authors less emotional, irrespective of the demographic cohort they belong to. This suggests that the authors in our two corpora reduce emotionality in their prose together and in parallel: emotionality does not decrease “one funeral at a time”, as new generations of writers replace the previous ones.

To confirm and illustrate this finding, we considered how emotionality changes, through time, in the eleven writers of our two samples that had the longest and most productive career (Supplementary materials 3). Nine of these writers’ oeuvre shows an emotionality decrease with time. Since we know, from previous analyses, that age is not a key determinant in this decrease, we conclude that these writers follow an endogenous cultural dynamic. In addition, we take the fact that the emotionality decline can be identified inside the individual work of very productive authors as a tentative confirmation that the decline was not due to changes in the kind of literature favoured by readers over the years.

A decline in happiness is implausible

The fall of positive emotionality is all the more puzzling since life does not seem to have gotten worse, in English-speaking countries, in the last two centuries. The opposite would seem more likely: material conditions of life got better by an order of magnitude (Clark, 2009). Subjective well-being is notoriously difficult to measure, but the little data we have shows no decrease in self-reported happiness and life satisfaction, whenever it has been measured: in the USA between 1946 and 2004, or in Western Europe between 1973 and 2004 (Veenhoven & Hagerty, 2006). We also note that the decline of positive emotionality is not matched by a comparable rise of negative emotional expression in any of our corpora. While an analysis similar to the one we presented here could detect the presence of distinct periods of positive and negative “mood” in published literature, correlated with socio-economic events (Bentley, Acerbi, Ormerod, & Lamos, 2014), the extent to which positive emotionality correlates with subjective well-being is still a moot issue (Tov et al., 2013). The general trend that appears clearly is that the tone of fiction literature became less cheerful over time (emotionality as measured by the LIWC reliably tracks the tone and mood of textual material – Kahn et al., 2007).

Commercial success

One thing that might conceivably drive the emotionality decline is cultural selection for a repressed, low-toned literary style. Even though the extant cultural evolution literature argues against this view, we sought to test it by considering the presence of the books in our two small data corpus on the personal libraries indexed online by the website Librarything.com. Success on this website obviously reflects a book’s impact on today’s readers, rather than in its own time, but we can reasonably expect the two to be correlated. The results, given in Supplementary materials 4, did not show the predicted effects. Emotionality is a poor predictor of a book’s inclusion in today’s online-indexed libraries. We also noted that the emotionality of the books in corpus B, almost all written by obscure authors, shows a great deal of overlap with the books of corpus A (see Figure 2) that are all celebrated classics (see above).

A historical weakening of the Pollyanna effect

The emotionality decline suggested by our data can be seen as a weakening of the well-known “Pollyanna effect”, a general tendency to use positive words more often than negative ones. There is a Pollyanna effect for word *tokens*: positively valued words are more frequently used than negative ones (Boucher & Osgood, 1969; Kloumann et al., 2012; Samothrakis & Fasli, 2015; Warriner & Kuperman, 2015), which this study replicates. We find that words associated with positive emotions are used, on the whole, nearly twice more often in our corpora. This explains how a decrease that is almost entirely restricted to positive emotions can have a considerable impact on literature’s emotionality as a whole: changes in emotionality are roughly twice more sensitive to changes in the expression of positive emotions, compared to negative ones.

One aspect of the Pollyanna effect that arguably fails to obtain in the special case of emotional vocabularies concerns word *types* as opposed to word *tokens*. Overall, in addition to being frequently used (and independently of this), positively valenced words are also more numerous (Dodds et al., 2015; Kloumann et al., 2012; Warriner & Kuperman, 2015). For emotional words, however, the reverse seems to obtain: vocabularies are larger for negative affect (Rozin & Royzman, 2001; Schrauf & Sanchez, 2004; the LIWC has 408 positive terms for 499 negative

terms). For this reason, it was important to make sure that the emotionality decline also obtains when controlling for an author's vocabulary size, as we did.

We do not know what causes the Pollyanna effect, at least as far as it applies to emotions, but our findings suggest that its strength could be dependent on historical and cultural factors. Our findings contradict at least two extant hypotheses regarding cultural changes in emotion expression. The first, inspired by evolutionary psychology, holds that negative feelings possess a specific cultural appeal, derived from the high evolutionary relevance of negatively valenced events, and the psychological saliency of negative feelings (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Fessler, Pisor, & Navarrete, 2014; Nichols, 2002). Our study, however, does not detect a substantial and reproducible increase in the expression of negative emotionality. Instead, we find that the Pollyanna effect is weakened in the opposite (and least expected) way: the decline is overwhelmingly driven by waning positive emotionality.

The second account, coming from cultural history (and limited to the United States) holds that a change in norms and mentalities, reflected in self-help books, child-rearing manuals, legal practice, literature, etc. brought about a reevaluation of emotional coolness, in the space of a few decades between the 1920s and the 1950s (Pountain & Robins, 2000; Stearns, 1994). If our data are accurate, this account is brilliantly perceptive, but wrong. There was indeed a decline in emotionality during those years, but the decline predates this period by far. One can easily, too easily, find cultural trends or creations that pre-date, announce, or parallel the two-centuries decline of emotionality documented here: Castiglione's *sprezzatura* (Castiglione, 1528/2009); the British "stiff upper lip"; Miles Davis' *Birth of the Cool* (1957). Yet to explain the decline of emotionality by such factors would either get the timing wrong or result in underspecified hypotheses.

Impersonal interactions

Another hypothesis would see the decline of positive emotional expression as a consequence of the development of impersonal interactions. The period we consider was a time of massive urbanisation; it also saw a marked decline in problematic behaviours such as theft or murder (Elias, 1978; Pinker, 2012). In other words, living peacefully among strangers became the norm, not the exception (Seabright,

2010). There is some empirical evidence (and some informed speculation as well) that such impersonal coexistence involves a decrease in displays of positive emotions. In Daniel Nettle's study of *Tyneside Neighbourhoods* (Nettle, 2015), two communities are compared, one where incivilities, conflict and crime are rampant, the other a picture of peaceful coexistence. As Nettle finds out, life in the less tranquil of the two neighbourhoods involves considerably more socialisation (not less). Greetings, in particular, are much more frequently seen in the deprived neighbourhood. Greetings are known to involve a great deal of positive emotional displays (genuine or assumed) in every society that has been studied from this angle (Duranti, 1997); by this and other means, inhabitants of the deprived neighbourhood, where social life is much less anonymous and much less peaceable, constantly monitor one another. Nettle's account chimes in with the view that modernisation saw the rise of a new and somewhat more tempered bourgeois ethos (Hirschman, 2013; McCloskey, 2010): a quiet search for personal improvement took precedence over the exclusive quest for honour and reputation. A decrease in displays of positive emotions could make sense in this light. One first step to confirm this hypothesis would be identifying the decrease in positive emotionality in non-literary material from the period. Even if one did, however, a number of questions would remain unanswered: Why do negative emotions fail to follow the same course as positive ones? Why did early urbanising elites give rise to the romantic movement?

Regression to the mean

Results from our "small data" corpus suggest a possible way out of this conundrum, one that future studies should corroborate. Difficult as it is to get reliable data before 1800, our 2 corpora seem to show that emotionality did not always decline. Rather, the Romantic period saw a flaring of emotionality, followed by a long and clear decline. If we assume that each writer tends to copy her predecessors' emotional style with a random error factor that is distributed around a certain mean, and that writers, at one point in time, are disproportionately influenced by a group of writers who happen to write well above the mean (perhaps simply by chance occurrence) we should then observe a steady regression to the mean (Galton, 1886), as each writer reverts to a normal level of emotionality.

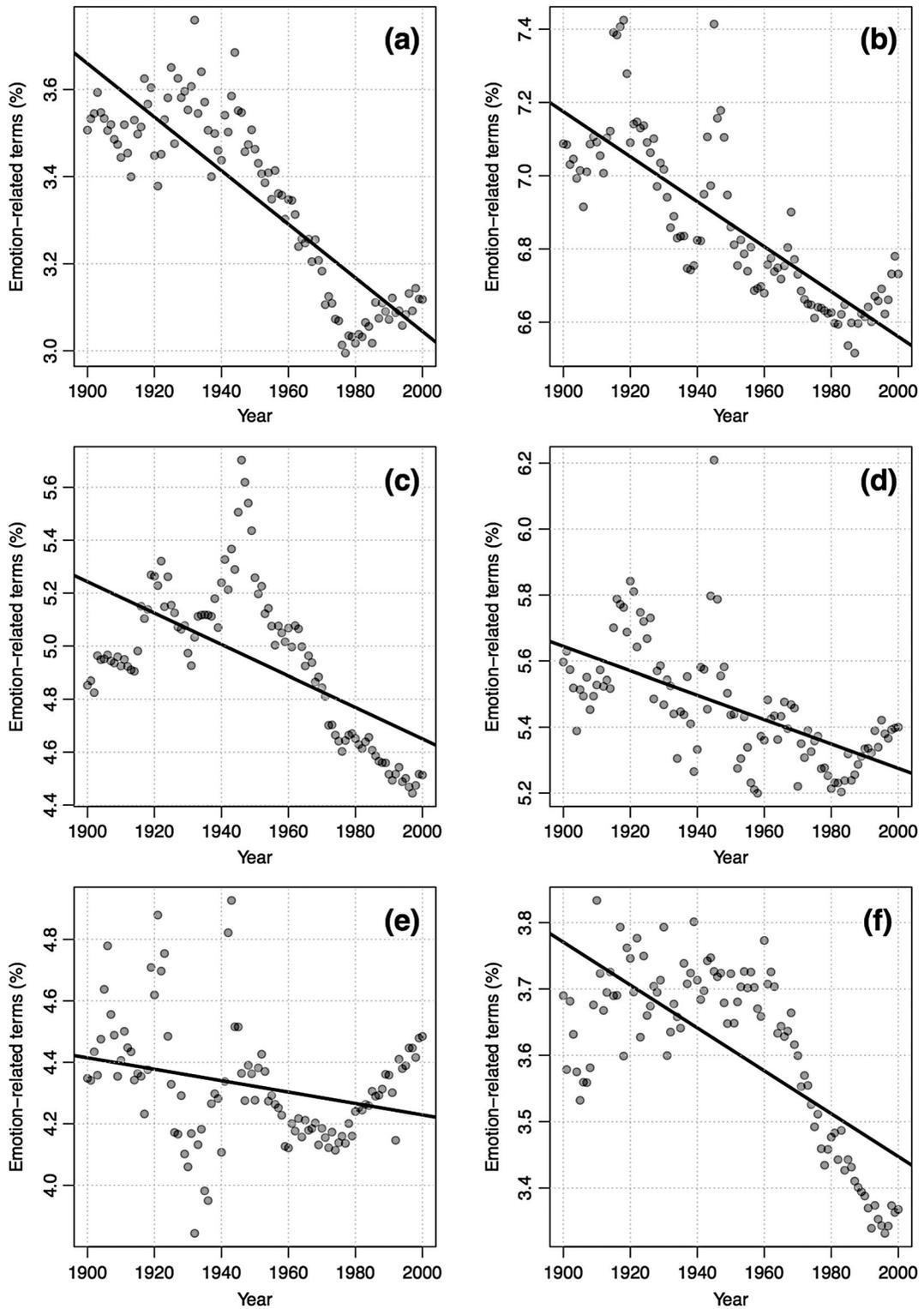


Figure 4. Emotionality changes in six additional Google Books corpora. (a) British English (texts in English language published in Great Britain). (b) French. (c) German. (d) Italian. (e) Russian. (f) Spanish. Solid lines represent linear regressions of the data. See Supplementary materials 5 for details of the analysis.

Several predictions can be derived from this conjecture.

First, the emotionality decline should taper off with time: the further from the mean we are, the faster the slide towards the mean. Our data do not contradict this prediction: the measured rate of decline for our corpus A (1696–1923) and our corpus B (1725–1943) is almost twice higher (on average, 0.07% per year, implying a rate of 0.7% per century) than in the Google Books corpus (showing a 0.4% decrease from 1900 to 2000, a decrease much more visible in the first half of the twentieth century than in the second). The heterogeneity of our corpora, however, means that these considerations are only speculative.

Second, a similar trend should be visible in all the literary traditions that were exposed to the Romantic influence. This seems true of all European countries documented by Google books: we find that the French, British, Italian, German, Spanish, and Russian corpora exhibit a decrease in emotionality (see Figure 4 and Supplementary materials 5). These analyses, however, were performed using adaptations of the LIWC which are not directly comparable with the English version, and on Google Books corpora that probably contain a great deal of non-fiction material.

Conclusion

More work is needed to test this regression to the mean hypothesis. We only know that the expression of emotion in fiction dwindled steadily over the course of the last century and a half (and perhaps before). This dynamic was driven by a collapse in the expression of positive emotions. Our results validate previous uses of the Google Book corpus; they also underscore the need for studies based on smaller, but metadata-rich samples. The pattern found by Acerbi et al. also challenges the view that emotional content should be favoured over other types of content in cultural evolution. Thus, one of the most studied and best-documented psychological bias in the field of cultural evolution fails to predict a robust and long-standing historical dynamic. Finding a satisfactory solution to this puzzle would take, we suspect, nothing less than a broad alliance between students of cultural evolution and literary theorists.

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