

The Age Chameleon: Social and Biological Effects on Madonna's Ageing Voice

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Abstract

This paper studies the dynamic interplay between social, chronological, and biological types of age, particularly how their complex imbrications differentially impinge upon the linguistic expectations of age and ageing women. In order to do so, we conduct a real-time quantitative analysis of interviews with the American singer and songwriter Madonna. Our acoustic analyses of Madonna's fundamental frequency, F1 and F2 indicate that Madonna presents as difficult to classify in terms of her age profile. We suggest that both f_0 and vowel quality variation are used to index age non-specificity, or agelessness. The analyses also provide a window into how the biological and social aspects of age and ageing are negotiated across a female's life span.

Keywords: age; ageism; Madonna; vowel quality; voice; voice change within the lifespan

'To age is a sin.' Madonna (2016)

1. Introduction

Although 'to age', as Madonna asserts, 'is a sin', Madonna herself and the copious public commentary about her age in recent decades illustrate the contingencies of this sinfulness: what might prove even more transgressive is *how* you age. The present paper explores this tension by engaging with Madonna's vocal ageing over time. It discusses evidence that she is taking control of that ageing by consciously or unconsciously minimising the physiological effects of age on her speech production, and

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by taking different routes to social ageing than her fellow sexagenarians. In this way, the paper examines how, as she ages, Madonna is navigating the rules of age (mal)practice.

Such practice has explicitly been part of Madonna's self-presentation over time. More than 30 years ago in a 1992 interview with Jonathan Ross, Madonna rhetorically questioned whether one is 'just supposed to die when you're 40?' (Hiatt 2015). In a 2015 *Rolling Stone* cover issue, still highlighting the neglect of ageism by comparing it to the attention that homophobia, racism, and religious discrimination receive, Madonna, addresses ageism as the 'last great frontier' (Hiatt 2015). She also noted how ageism is gendered: '[Age is] still the one area where you can totally discriminate against somebody and talk shit, because of their age. Only females, though. Not males.' Indeed, as Sontag (1972) contends, a sexual double standard exists in relation to the perception of ageing men and women. For a woman, '[e]very wrinkle, every line, every grey hair, is a defeat' (Sontag 1972: 36). Accordingly, '[m]en are "allowed" to age, without penalty, in several ways that women are not' (Sontag 1972: 31).

Older females, moreover, are beset by discordant demands by adopting certain youth-based biological associations (such as a healthy, sexy body) while at the same signaling socially age-appropriate decorum. In other words, the gendered differential sexual norms of older people dictate the negotiation of *both* biological and social age, and their interactive relations. These considerations showcase the complex ways in which gender, and social and biological age processes interact in influencing our perceptions of our peers.

In addition, recent work on the sociolinguistics of ageing calls for an increased focus on approaching age and ageing as stylistic identity work, where speakers stylise their linguistic behaviour in order to perform differently aged personae (e.g., Hejná and Jespersen Forthcoming; Jespersen and Hejná Forthcoming; Hejná Forthcoming; Pichler et al. 2018). However, while age is a key social factor frequently considered in sociolinguistic research, it rarely goes beyond the confines of chronology: the number of years lived. This paper seeks to contribute to the growing body of constructivist approaches to the linguistic construction of speakers' age identities and personae.

In addition, this paper seeks to unite a biological view of the ageing body—what we term Madonna's *biological age*—with considerations of Madonna's *social age*—here, conceptualised as her adherence to, or self-

distancing from, the norms of her age group over time. We also consider the effects of changes in Madonna's geographical location as a potential source of variation. Finally, we discuss the degree to which any age effects are informed by Madonna's gender. To these ends, our research questions are as follows:

1. Does Madonna, a woman in her sixties, seem to employ vocal changes to perform youth, attractiveness, maturity, or to transcend the boundaries of age?
2. More specifically, do Madonna's f_0 and/or F1 and F2 pattern as can be expected from
 - a. typical changes to her physiology?
 - b. relevant dialectal changes associated with her generation?
 - c. changes in her musical persona?

2. Gender and social age in sociolinguistics

We argue that both age and gender are informed by biology as well as the social—that is, they are both, in part, performative. While this performance is enacted through many disparate channels, one key semiotic resource in this game is language (Kulick 2000: 265–270). Early sociolinguistic work has argued that women tend to be more involved in using symbolic resources (Eckert 2000), and that this has an effect on how women tend to use language forms which are undergoing change. For instance, linguistic changes which speakers in a community are aware of, and which are often afforded high status, tend to be used more by women (cf. the Labovian Gender Principle I, Labov 1990). Such more positively evaluated forms often correspond to the linguistic national standard (e.g., Meyerhoff 2006: 207–220; cf. Milroy et al. 1994). On the other hand, linguistic changes which speakers are unaware of, and which are therefore not overtly commented on, tend to have women at the innovative forefront (Labov 1990; Eckert 2000: 118).

Since having established such general patterns, the field of sociolinguistics has taken a constructivist turn. An important turning point was the publication of Ochs (1992) and the sociolinguistic adaptation of the theory of indexicality. This idea is that the connection between language and social category is rarely a direct one; instead, linguistic forms may *index* stances, acts and activities that are *then* linked to social categories. In this way, a person can employ linguistic features which index uncertainty, and thus powerlessness, to perform a marginalised

persona such as that of a woman. Ochs' work was later reemphasised by Eckert (2008, 2012), who noted that indexical links are themselves indeterminate and only really emerge in styles associated with relevant contexts of interaction. In order to investigate whether a certain linguistic feature is used to signal femininity or age we must, therefore, examine it in contexts in which the speaker wishes to perform gender or age roles. For instance, Podesva (2007) showed how a gay medical doctor named Heath used falsetto voice quality in the company of his friends at a barbeque to index expressivity and thus perform a 'diva' persona, while on other occasions, such as when speaking to his father on the phone or to patients at a health clinic, this use of falsetto was not employed.

Indexes, and the links between index and social categories, can also be exploited to subvert stereotypical categories. This is shown by Barrett's (1997) work with African American drag queens, who draw on and recombine features associated with white Southern women and African American men to perform personas of both gay men, drag queens and African Americans. What sociolinguistic work has thus taught us is that the performance of gender and sexuality is fluid and transformative—for instance, we now know that we cannot find one set of language features that are characteristic for women and one for men. We also know that gender and sexuality do not have uniform effects on the linguistic behaviour of whole communities, nor of individual speakers.

One particular facet of the interplay between language and gender which is severely under-researched (cf. Eckert 1989: 212–213; Eckert 1996) is language use and gender among the ageing. Recent work on language and ageing (Coupland, Coupland, and Giles 1991: viii–2; Wagner 2012; Pichler, Wagner, and Hesson 2018; Hejrná and Jespersen 2021) has similarly highlighted two problematic facts about the field of sociolinguistics: it has tended to overlook the speech of older individuals, and its consideration of age, an important cornerstone in examining speech patterns, has been limited to chronology. That is, researchers have surmised that the year a speaker was born adequately reflects their age, and that there is a relatively straightforward relationship between a speaker's chronological age and the way one speaks. However, as shown by, e.g., Dubois and Horvath (1999), a speaker's chronological age does not necessarily explain linguistic patterns better than the social aspects of age, i.e., a person's perceived belonging to specific age groups, and the effects such belonging has on their social roles and relationships. Pichler

et al. (2018), Hejná (Forthcoming), and Hejná and Jespersen (2021, Forthcoming) thus call for a more nuanced approach to speakers' social age, and for combining this focus with other aspects of a person's individual age trajectory, especially those influenced by biology. Investigating the voice is a good starting point, because it has been well established that it can be directly impacted by physiological changes to the speech organs as we age (Eichhorn et al. 2018). However, it is far from straightforward to differentiate physiological and social effects on the ageing voice, as will also be seen in our analyses.

3. Case study: Madonna's ageing voice

We present an examination of the intertwining of age and gender conducted through the lens of one individual, Madonna, and her production of speech at different points within her lifespan. We start by correlating Madonna's linguistic behaviour with her chronological age at different time points, and then interpret this correlation through comparisons with expected physiological changes to the voice. Finally, we also consider how sociocultural norms and social roles might affect her changing speech patterns. Through analyses of changes in the pronunciation of nine different vowels and spoken pitch within Madonna's lifespan, we suggest that the artist *performs* age. More specifically, she performs age by not generally conforming to the vowel changes characteristic of any of the generations of the speakers found in the English-speaking regions where she has resided. This way, one could argue that Madonna performs agelessness or age indeterminateness, producing vowels and pitch patterns which are difficult to classify in terms of generations and thus socially-specific age categories.

3.1 Quantitative analyses

The first part of our analysis focuses on Madonna's production of a number of specific vowels. We zoom in on such micro-aspects of her speech for two reasons: firstly, the production of vowels is something the speaker can manipulate to some extent, meaning she is able to consciously or unconsciously alter her vowels to suit her preferred speech persona. At the same time, we know how comparable speakers of Madonna's generation tend to produce their vowels, and we are therefore able to compare Madonna's vowels with vowels produced by others of her generation, as well as older and younger speakers.

For this paper, we investigate the vowels found in the words TRAP, LOT, CLOTH, STRUT, KIT, DRESS, and THOUGHT/NORTH/FORCE (see Wells 1982: 483–484 on THOUGHT/NORTH/FORCE). These vowels were chosen for the analysis because they have been known to undergo different linguistic changes characteristic of specific generations in the three regions relevant for Madonna's residential history: Michigan, where she lived until the age of 20 (until 1978); New York (from 1978); and Los Angeles (2003–2012). Madonna's places of residence become trickier to establish as we move through her career. She currently owns properties in various places in the US, the UK, and Portugal. She also resided in England during her marriage to Guy Ritchie (2000–2008). Between 2017 and 2020, her primary residence was Lisbon, and in 2020, she moved to London. These geographical specifics—as well as the fluidity of the multiple residencies and working across the globe—should be borne in mind during our interpretations of whether or not Madonna sounds her chronological age. On one hand, in Madonna's case, her sheer multitude of homes speaks to her recognition as a globally recognised and relevant public figure. The increasingly global nature of her career may have put (real or imagined) normative pressures on Madonna to disconnect her speech from local norms, for instance pressures from the media. On the other, we cannot rule out the effects of a speaker's residence on their speech during their lifespan, and we therefore need to take the possibility of geographically-associated variation into account. In Nycz's (2015) overview of second dialect acquisition, it is clear that it is possible, and potentially even probable, for speakers to adopt at least some features of the local variety when moving to a new dialect area—even as adults, and even in the case of fine-grained phonetic variation like vowel realisation (473–475).

Apart from variation in vowels, our analysis also takes into account the overall pitch level of Madonna's speech. Like vowels, pitch is well known to undergo changes within one's lifespan due to physiological ageing of the larynx (Nishio and Niimi 2008; Raj et al. 2008; Reubold, Harrington, and Kleber 2010). More specifically, for female speakers f_0 tends to drop around menopause, and variation in f_0 is associated with speech marked by increasing loss in one's motorcontrol abilities (usually identified after retirement). Furthermore, overall pitch levels, pitch spans and individual pitch movements have been reported as something speakers consciously manipulate for social ends (see, e.g., Warren 2016; Jespersen 2016; Jespersen 2018).

Our analyses of the vowels and pitch are based on examples of Madonna's speech taken from interviews on a number of TV shows. The concrete interviews chosen were included based on their audio quality, and to coincide with important points in Madonna's career. The information about these interviews can be found in the Supplementary materials available via the Appendix. This information includes details about who the interviewers are, where the interviewers come from (relevant for our understanding of their accent), what year the interview was conducted in, and what topics were discussed (Table A). All interviews were carefully selected to be as comparable as possible in terms of these parameters. In addition, Table B in Supplementary materials provides information about Madonna's studio albums and the themes and personas associated with each album across the years in order to shed light on any year-specific changes which may emerge in our analyses.

The interview sound files were extracted from YouTube interview videos with Audio Hijack (Rogue Amoeba 2002) as .wav files. These files were then further processed in Praat (Boersma and Weenink 2019) to 1) identify the vowels of interest, 2) (manually) determine the boundaries of these vowels, and 3) extract two measures relevant to pitch and vowel production. The first of these, f_0 , roughly corresponds to our perception of the pitch of an utterance. Although a person's spoken pitch changes continuously throughout an utterance, taking the average of a speaker's pitch level at various points is a simple and efficient way of gauging the general pitch level employed by Madonna as she speaks. The second measure is known as formants, specifically F1 and F2. These roughly correspond to the position of the tongue in the mouth when the vowel is produced. These measures also indicate crucial aspects of the quality of the vowel as it is being spoken. Both measurements were made at the midpoint of each vowel to ensure that these were less likely to be coloured by the characteristics of neighbouring speech sounds. Our analyses included 3758 tokens (see Table 1). f_0 , F1, and F2 measurements were visually checked for outliers. Outliers due to measurement errors were generally removed. In case of f_0 , five outliers presented measurement errors due to octave jumps. These were manually corrected. Any remaining f_0 outliers which were not measurement errors were kept in the dataset (e.g., those occurring due to the use of falsetto). For F1 and F2, we removed outliers based on visual inspection of each formant. We identified 29 outliers in our F1 measurements and 15 in our F2 measurements. These

were distributed across the different vowel phonemes (F1: 7*TRAP, 1*DRESS, 2*KIT, 7*LOT, 2*THOUGHT, 10*STRUT; F2: 2*DRESS, 4*KIT, 3*LOT, 3*THOUGHT, 3*STRUT).

Table 1: Number of tokens by lexical set / vowel phoneme by decade (Including 29 F1 and 15 F2 outlier tokens)

Decade	TRAP	DRESS	KIT	LOT	THOUGHT	STRUT	Total
1980s	120	137	61	91	69	64	543
1990s	188	225	218	171	93	117	1012
2000s	204	245	238	163	117	121	1088
2010s	192	299	179	183	112	150	1115

The visual and statistical analyses were conducted in R (2025) with RStudio (2025). Linear mixed effects regression models were constructed using *lme4* (Bates et al. 2015) and *lmerTest* (Kuznetsova et al. 2019). The analyses originally quantified age via DECADE (levels: 1980s, 1990s, 2000s, 2010+). However, this approach to age proved too simplistic. Firstly, the trends we find are not linear. Secondly, looking at age through the decades masks important year-specific nuances (see, e.g., Figure A in Supplementary materials and contrast it with Figure 1 below). For this reason, the year of recording (YEAR) was coded as a categorical variable, and it was further forward-coded in all models. This means that comparisons between successive years were consistently applied in all analyses. In all models used, WORD and INTERVIEWER were entered as random effects, and preceding and following phonetic environment were entered as independent variables. Preceding environment was operationalised with six levels (approximant, nasal, pause, voiced obstruent, voiceless obstruent, vowel), and following environment with four (approximant, nasal, voiced obstruent, voiceless obstruent), corresponding to what environments existed in the dataset. Approximant was used as a reference level. One model was used with f_0 as a dependent variable: $F0 \sim \text{Vowel} + \text{Year} + \text{Following environment} + \text{Preceding environment} + (1 | \text{Word}) + (1 | \text{Interviewer})$. DRESS served as the baseline in the f_0 model, being consistently the most frequent vowel occurring in the interviews over Madonna’s lifespan.

For analyses of F1 and F2, one model was run per vowel phoneme: once with F1 and once with F2 as the dependent variable. This resulted in 2*6 models, corresponding to two dependent variables and six vowel phoneme categories. The models were the same as for f_0 in case of DRESS, KIT, and STRUT. However, an interaction between YEAR and FOLLOWING ENVIRONMENT was entered in models for TRAP, LOT, and THOUGHT.

To interpret the models, the *effects* package was used (Fox et al. 2020), and in order to graph the results, *ggplot2* was employed (Wickham 2016). The full statistical details are available in the Supplementary materials (see Appendix).

3.2 Physiological changes to the voice with age

3.2.1 Pitch

Raj et al. (2008) have shown that female pitch typically drops during and after menopause (see also Reubold et al. 2010), which is linked to the fact that high tones can be lost, causing a narrower pitch span. For instance, Raj et al. (2008) report a mean pitch level of 226Hz for their menstruating participants and 205Hz for their postmenopausal participants. In the case of Madonna, we would therefore predict a significant lowering of her overall pitch level at approximately the age of 47–50 (which has been reported to be the average onset of the menopause for American women; see, e.g., Tunick 2000), and we might also see a smaller drop in pitch levels at around 40, when the onset of perimenopause may have commenced. However, there is a considerable amount of individual variation, and the onset of menopause has recently been documented to come later in at least some western societies (Tanbo and Fedorcsak 2021). Furthermore, the effects of menopause on speech production might be mitigated by hormone replacement therapy, which—if relevant for Madonna—would reduce or even negate changes to Madonna's pitch levels (see, e.g., D'haeseleer, Depypere, and van Lierde 2013). Importantly, Madonna has been claimed to prefer 'bio-identical hormone replacement therapy' (The Marion Gluck Clinic 2022).

In general terms, then, a change resulting either in lower pitch levels (or indeed the absence of any change) could be ascribed to physiological effects on the larynx. However, it is worth noting that although hormone replacement therapy centres on physiology, this intervention is intentional and in and of itself does reflect agency on the part of the individual undergoing the therapy. If, on the other hand, Madonna's pitch is found to

be rising, this would most likely indicate agency on the speaker's part. One reason for such a change could be tied in with the fact that higher pitch in female voices is seen as attractive (see, e.g., Xu et al. 2013).

3.2.2 *Vowels*

We are fairly certain of what happens to one's pitch as one ages. We are, however, much less certain when it comes to the changes in vowel quality. The higher formants—F2 and F3 (and F4)—have not been reported to display systematic age effects (Reubold et al. 2010). This is partly because chronological age is taken as a proxy for biological age, and not all researchers take potential social factors into account (see, e.g., Romenesko et al. 2016). We cannot rule out that this is what leads to inconsistent results from study to study, across the sexes and from vowel to vowel. The indicator of vowel height included in this study, F1, has been claimed to show an overall tendency for lowering as one ages, and in females in particular (Eichhorn et al. 2018). In this way, Harrington and colleagues (e.g., Harrington, Palethorpe, and Watson 2005; Harrington 2006) provide evidence from analyses of Queen Elisabeth II's vowels (and those of other celebrities), which points to her vowels' F1 lowering throughout the Queen's life course.

It has been proposed that the reason for F1 lowering may be bound up with the lowering of a speaker's pitch, which may either have the add-on effect of also lowering F1 (Harrington 2006: 451), or of making the speaker subconsciously try to adjust for this physiological change by altering their articulation when speaking, producing vowels with a lower F1 (Eichhorn et al. 2018; Reubold et al. 2010: 649). Another view is that as a speaker ages, their larynx lowers, which results in lengthening of the area between the larynx and the mouth, or in an increased volume of the oral cavity, both of which may influence the resonances produced when speaking (Reubold et al. 2010). Higher formants, such as F2, may also be affected.

3.3 *The influence of place: socially conditioned language change*

In order to have a reference point for the social changes that might happen to Madonna's speech as she ages, we also need to consider the context of the sound changes affecting vowels in the regions that could be considered most obviously relevant for Madonna. This is because the specific articulation of each vowel may be associated with different generations

depending on the region. Such generationally salient variants can be used by speakers to position themselves in the generational landscapes that surround them—in other words, also for age identity work. This means we need to account for geographically associated vowel changes both to control for this influence when arguing for an age-relevant interpretation of her vowels, but also because these changes form the backdrop of the artist's age identity work. In Madonna's case, the vowel changes of particular interest are those reported in Michigan, New York, and Los Angeles. Moreover, we account for general vowel changes to match her global way of life as a pop star (see, e.g., Hickey 2018).

3.3.1 *Michigan: Madonna's linguistic upbringing*

In this section, we present an overview of some of key vowel changes known to take place in Michigan, where Madonna was born and brought up.

One of the best-known vowel changes affecting the Inland North (i.e., also Michigan) is the Northern Cities Shift (see, e.g., McCarthy 2013; Wagner et al. 2016). This shift involves a series of vowel-specific movements which span several generations, and differences in one's participation in the Northern Cities Shift (NCS) could therefore be interpreted as a way to signal one's affiliation with a generation. In the NCS, vowels in words such as TRAP become higher (resulting in a lower F1) and fronter (higher F2). The COT vowel fronted (higher F2) and THOUGHT lowered (higher F1). Furthermore, the STRUT vowel became retracted (resulting in a lower F2), DRESS lowered (higher F1), and KIT lowered (higher F1). One can therefore interpret vowels that conform to these patterns as being part of an Inland North identity, as well as see whether Madonna's vowels conform to earlier or later vowel changes within the NCS.

Based on the evidence presented by Wagner et al. (2016), any generations of speakers alive within Madonna's lifespan can generally be expected to show the completion of the more established vowel changes of the Northern Cities (see Wagner et al. 2016 and Dinkin 2011 for potential exceptions). We would also expect that showing continuous DRESS retraction, a later addition to the shift, would signal a younger outlook, since this vowel realisation is characteristic of younger generations of speakers. Continuous STRUT retraction (and possibly

lowering), and KIT lowering could be interpreted as signalling a younger outlook as well.

Considering the fact that Madonna has not resided in this dialectal area since 1978 and became—and has remained—an internationally recognised artist in and since the 1980s, we might expect her speech not to show (too many or too noticeable) variants associated with the changes described in this section. Furthermore, as will become apparent in what follows, similar changes have been reported in other dialects, which we might expect to be recruited for youthful identity work. Great care therefore must be taken when interpreting specific vowel changes as what seems to be the same change might have different indexical interpretations in different regions.

3.3.2 *New York: youth and commercial success*

One of the topics frequently discussed in the interviews with Madonna analysed in this paper (see the Supplementary materials) is that of her move to New York in 1978, with the goal to pursue a career as a dancer. She earned her living working at Dunkin' Donuts, as a waitress in the Russian Tea Room, and posing for nude photos. In the interview with Sean Evans (2015), it becomes clear that the artist has fond memories of the local art scene and her residence in the New York of the 1970s. Since New York was one of her homes and—at least in the 1970s—the centre of her artistic career, it is likely that Madonna might use some features associated with New York City English (NYCE) in the earlier interviews, before her outlook seems to have become more global.

Some of the numerous vowel changes related to NYCE which have been studied in terms of age include the ones happening to the TRAP and CAUGHT vowels. Regarding TRAP, Becker and Wing-mei Wong (2010) report that older and middle-aged speakers (which is where Madonna would fall based on her chronological age) use the traditional short-a system, which presents us with a raised and an unraised variant of TRAP. Younger speakers, however, show partial movement towards a nasal system, where TRAP raises before a velar nasal. Considering CAUGHT, this vowel has been lowering in NYCE (Becker 2014) and white speakers of Madonna's chronological age can be expected to have fairly lowered values. The motivation for the traditionally raised CAUGHT lowering in NYCE has been linked to the negative stereotypes of *classic New Yorker* linked to this pronunciation. Furthermore, not using the high CAUGHT

vowel is also linked to the CAUGHT-LOT merger, discussed further below, which is associated with a change in progress across a range of North American varieties of English, and which we would therefore expect Madonna to participate in to index a more youthful and global persona.

3.3.3 California: an established career trajectory

Madonna moved to California after her career became successful. We therefore also need to account for changes associated with Californian English.

This variety is associated with notable vowel changes, such as the ones known as the California Vowel Shift (Hinton et al. 1987; Kennedy and Grama 2012; D'Onofrio and Pratt 2019; Podesva et al. 2015; as well as the contributions in the special issue edited by Becker 2019). These include the merger of COT-CAUGHT, the fronting of GOAT, GOOSE, and FOOT, and the lowering and the centralisation of TRAP, DRESS, and KIT in non-nasal contexts. Before a nasal, TRAP raises and fronts.

Based on the results presented by Podesva et al. (2015), we would expect individuals of Madonna's chronological age to show some participation in these changes, but to a limited extent. On the other hand, speakers with an urban as opposed to a rural outlook are expected to be participating in the shift more vigorously (Podesva et al. 2015). Based on the results of Kennedy and Grama (2012), where one speaker slightly older than Madonna is contrasted with speakers approximately 30 years younger, we might expect Madonna to participate in the lowering of KIT and DRESS, but not necessarily in the lowering and centralisation of TRAP. Indeed, we do not know to what extent individual-specific results, reported for a range of vowel shifts in North American English (see, e.g., Becker 2019: 14) might be explained by considering age beyond one's chronology. However, we would expect to see these more global vowel changes reflected in Madonna's speech after the 1980s, and perhaps increasingly more so with the artist's increasing chronological age: Madonna has frequently dealt with critique linked to age-inappropriate behaviour, usually because of acts normatively perceived as appropriate for younger women.

3.3.4 *Wider changes—the global marketplace*

As Madonna's career increasingly becomes global, her voice can be expected to show evidence of less geographically-linked vowel changes. We therefore present two relevant examples below.

Hickey (2018) has identified a phenomenon he has labelled Front Short Vowel Lowering (see also Becker 2019). This shift involves the lowering of KIT and DRESS, and the retraction (and lowering) of TRAP. These vowel changes are reported in many varieties of English (as we have seen above; see also Clark, Elms and Youssef 1995: 212). On the whole, then, KIT, DRESS, and TRAP lowering, and TRAP retraction can be interpreted as signalling 'non-elderly' in the global landscape. This is also the case for GOOSE fronting: while it is one of the components of California Vowel Shift, it has also been reported to take place in a range of varieties of English (see, e.g., Hickey 2018).

Apart from these changes, as also noted by D'Onofrio and Pratt (2019) and Eckert and Labov (2017), it is worthwhile to consider the holistic size of a speaker's vowel space in terms of compression and expansion. Most notably here, larger vowel spaces are associated with more feminine personae (Eckert and Labov 2017, citing Ohala's frequency code: Ohala 1994), which is important to consider for the ageing process of female speakers in particular. At the same time, as we age and our vocal tracts grow larger, we generally also expect these biological effects to result in somewhat small vowel spaces (see, e.g., Hejná and Jespersen 2022). Female speakers in particular therefore have to mitigate the negotiation of youthfulness and attractiveness as they age. Findings by D'Onofrio and Pratt (2019) nevertheless also show cases where younger generations show smaller rather than larger vowel spaces when compared to older generations. Crucially, the authors explain these patterns by the articulatory effects of protruded articulatory settings associated with tropes such as the Surfer Bro and the Valley Girl. When considering Madonna's vowel space, we must therefore carefully consider not only her ageing trajectory but also what kind of persona she generally adopts during her lifespan. She does not adopt either a Surfer Bro or a Valley Girl persona, and we would therefore not expect her to compress her vowel space in line with what has been observed for younger generations speaking Californian English.

3.4 Results

3.4.1 Overall f_0

We first turn to analyses of Madonna's f_0 , which we predict will have lowered from the 1980s to the late 2010s due to the effects of hormonal changes during menopause. More specifically, we predict Madonna's f_0 to show a dip in her early fifties, as that is when the effects of menopause might be expected.

As shown in Figure 1, which plots f_0 across the individual years, there is indeed a drop in f_0 in 2013, when Madonna's chronological age is 55 years.

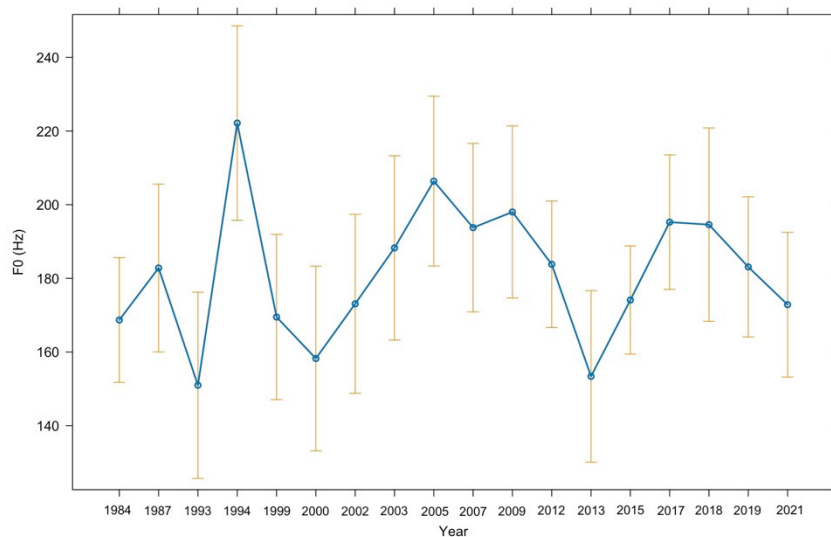


Figure 1: Madonna's f_0 by year

However, the trajectory of Madonna's f_0 warrants further discussion. Firstly, the dip in 2013 is not the only f_0 dip observable. Further dips can be seen in 1993 (when her f_0 is in fact the lowest) and also in 2000 and 2021. The 1993, 2000, and 2013 f_0 values are the lowest, corresponding to when Madonna is 35, 42, and 55 years of age. These patterns point to a fairly complex quartic rather than linear effect of age, and also to the possible effects of other indexicalities.

These non-linear effects were further explored through statistical analyses (Table D in Supplementary materials). As mentioned in our

methodology, year was forward-coded, which enabled testing whether *successive* years show significant differences. The model reveals that the rise in f_0 occurring from 1993 to 1994 is statistically significant ($\beta = 53.46$, $SE = 16$, $df = 15.7$, $t = 3.3$, $p < 0.01$). Similarly, the rise from 2003 to 2005 is also statistically significant ($\beta = 37.71$, $SE = 15$, $df = 10.9$, $t = 2.6$, $p < 0.05$), and the rises from 2007 to 2009 ($\beta = 29.33$, $SE = 15$, $df = 11.3$, $t = 2$, $p = 0.07$) and from 2015 to 2017 ($\beta = 26.57$, $SE = 13$, $df = 18.3$, $t = 2.1$, $p = 0.05$) approach significance. However, no other year comparisons result in significant differences. Tukey tests (Lenth et al. 2020) reveal significant differences in f_0 between the year 2014 with the highest values) and 2000 ($\beta = 63.92$, $SE = 19$, $df = \text{Inf}$, $t = 3.4$, $p = 0.06$), 2007 ($\beta = 28.39$, $SE = 8$, $df = \text{Inf}$, $t = 3.7$, $p < 0.05$), and 2013 ($\beta = 68.76$, $SE = 18$, $df = \text{Inf}$, $t = 3.8$, $p = 0.06$), where the last is the year with the presumed menopausal dip.

We now consider the role of the topic and the interviewer here as well. Madonna's f_0 tends to be higher in interviews with David Letterman, where the conversation tends to be on the flirtier side. Interestingly, the most flirtatious interview from 1994 is also associated with the highest values. In this interview, Madonna brings David Letterman her underwear as a gift and asks why he is 'so obsessed with [her] sex life'. However, this is the only topic-based and interviewer-based tendency we have detected which could shed light on Madonna's f_0 by year. Even though some other interviews are more flirtatious in nature (e.g., 2015), this does not seem to map onto Madonna's f_0 in most cases. Looking at the personas associated with the studio albums similarly does not shed light on any of the f_0 patterns observed in Figure 1, despite the fact that many of the interviews analysed contain promotional aspects of individual albums. What can be concluded, however, is that Madonna's f_0 is challenging to classify in terms of age across her lifespan, which corresponds to Madonna's ever-changing, difficult to classify performer persona(s).

We now turn to our vowel measures, F1 and F2, which give us an indication of how Madonna pronounced her vowels at different points in time. The full quantitative results are available in the Supplementary materials.

3.4.2 Overall F1

Madonna's F1 measures are affected by the year in which the vowels are spoken. These effects are shown in Figure 2.

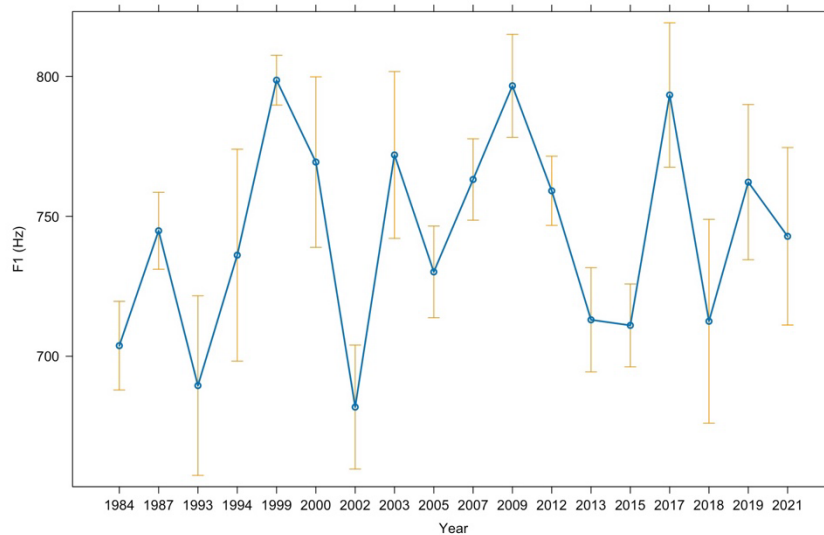


Figure 2: Madonna's F1 by year

If we inspect overall F1 patterns by year, as was done for f_0 , we see that no clear patterns emerge. On the one hand, this may not be surprising considering that we expect phoneme-specific changes to potentially operate in Madonna's vowel production. On the other hand, we do see a degree of correlation between f_0 by year as shown in Figure 1 and F1 by year as shown here. In light of the literature on the ageing voice, this overall tendency is interesting. The details of the mixed effects models used for F1 can be found in Table E in Supplementary materials.

3.4.3 Overall F2

Proceeding to any potential overall patterns in F2, Figure 3 suggests a generally lower F2 in the interviews from the 1980s than in the rest of Madonna's interviews. The details of the mixed effects models used for F2 can be found in Table F in Supplementary materials.

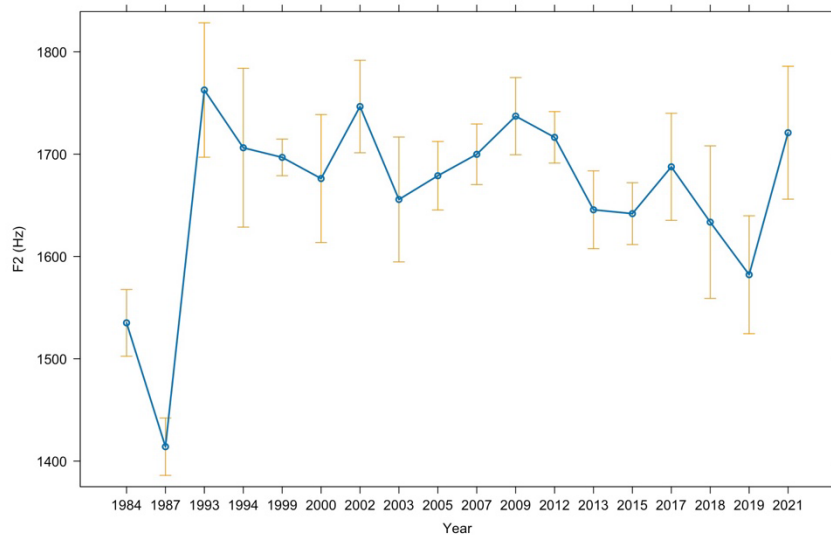


Figure 3: Madonna's F2 by year

In what follows, we report on changes affecting Madonna's overall vowel space (section 3.4.4.). We then provide phoneme-specific analyses (sections 3.4.5–3.4.6).

3.4.4 *Global vowel space changes*

While looking at individual vowel phonemes provides one type of information related to Madonna's ageing voice, an additional explanation of some of the formant changes reported above can be found in Madonna's vowel space in real time. Across the decades, the constellation of the vowel phonemes remains qualitatively largely the same. However, the vowel space generally seems larger in the data after the 1980s, as visible in Figure 4.

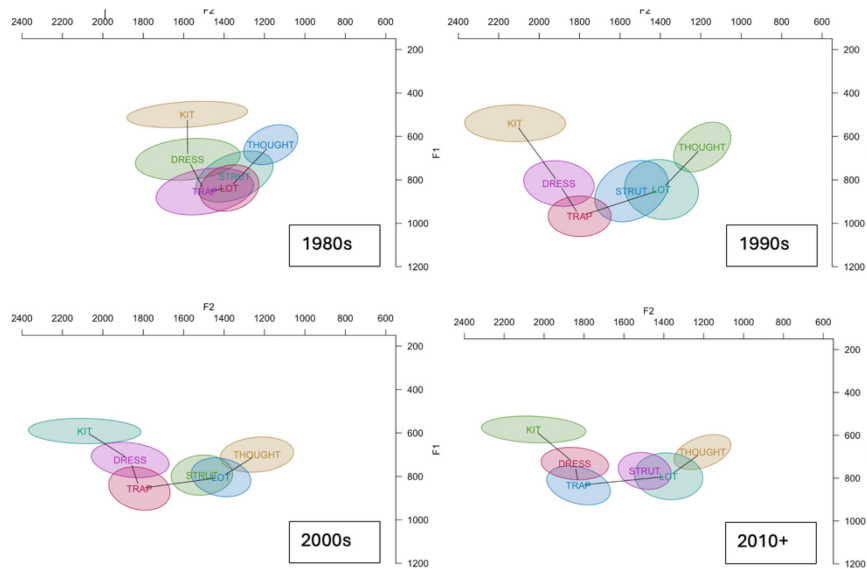


Figure 4: Madonna's vowel space

The 1980s are associated with the lowest F2 values on the whole. This is indeed also partially the case for F1, which shows the highest values in the 1990s and the lowest values in the 1980s. The 1980s F1 values are nevertheless comparable to those of the 2000s and 2010+. What we observe is an overall change whereby four of the six phonemes become associated with a higher F2 after the 1980s, these being DRESS, KIT, STRUT, and TRAP. LOT and THOUGHT show no significant change in time regarding F2. This reveals an overall expansion of the speaker's vowel space in the *front* direction. We discuss the implications of this in section 4.

3.4.5 LOT-THOUGHT

With respect to whether LOT and THOUGHT remain two separate categories over time, which could be associated with a more local and non-elderly outlook, the Tukey post-hoc comparisons conducted in conjunction with the final models used to interpret changes in F1 and F2 provide relevant information (see also Tables G and I in Supplementary materials). Within-decade comparisons reveal statistically significant differences in F1 and F2 between the two phonemes for each decade. However, the effect size

of this difference is the smallest in the 2000s and the 2010s, with these two decades also revealing a visual overlap between the two categories. Looking at Figure 4, we can indeed notice that the realisations of LOT and THOUGHT begin to encroach on each other in real time, even though this overlap is fairly slight.

3.4.6 *TRAP, DRESS and KIT*

Some of our vowel-specific hypotheses were linked to the TRAP, DRESS and KIT vowels. Tukey post-hoc comparisons carried out for each final model for F1 and F2 variation enables us to shed further light on the changes affecting these three phonemes: all three phonemes show fronting between the 1980s and the post-1980s decades. This is the case both in absolute and relative terms. For instance, the post-hoc comparisons reveal that TRAP is getting further away from LOT in real time, as judged by the increasing effect size of decade on the F2 difference between the two phonemes. TRAP and DRESS do indeed exhibit lowering, but crucially this takes place in the 1990s and disappears in the 2010s and 2010+. For KIT, lowering takes place in the 2000s and does not undergo further changes in 2010+.

To conclude this section, the reader is referred to Figure A in Supplementary materials for more visual details, including the effect plots of the final, most optimal model explaining Madonna's variation in F1 (Figure B) and F2 (Figure C).

4. *What does this mean?*

In the introduction to this paper, we discussed how biology and culture work together to condition the (de)sexualisation of older women. Our case study of Madonna serves as a very concrete example. More specifically, we aimed to shed light on, firstly, whether biologically-induced changes to the ageing voice can be manipulated, and to what ends; and, secondly, whether we are able to find patterns to suggest that Madonna employs vocal changes to perform youth, attractiveness, maturity, or, perhaps, to transcend the boundaries of age. What the linguistic analyses have made clear is that Madonna, as we might expect, is not behaving like an average woman in her sixties. More specifically, we suggest that Madonna performs vocal youthfulness which is intertwined with vocal attractiveness. Very importantly, this youthfulness presents a stance

against normative ideas associated with being elderly, and therefore not with being perceived as normatively attractive.

4.1 f_0

Regarding Madonna's f_0 , we could see that her overall pitch level starts at a rather low position for female speakers of American English (see, e.g., Hillenbrand et al. 1995: 3103, who report the average range of 210–235Hz for females). We see a rise in Madonna's f_0 in 1994, followed by a drop in the rest of the decade and a rise in the subsequent years. At the age of 55 (2013), Madonna shows a drop in f_0 , which is consistent with menopausal changes to the voice. This drop is followed by a rise in 2015, and her f_0 remains higher than in 2013 until 2021 (inclusive), which is where our analyses end.

Regarding f_0 , we argue that a combination of biological and social factors plays an important role in our interpretation of the patterns found, and that social factors should not always be divorced from the biological reality of speakers and communities. More specifically, we propose that the rise in f_0 might be a strategy to adopt a more youthful-sounding voice: higher f_0 is associated with hyperfemininity and normatively feminine and attractive voices (Redmond 2016; Babel et al. 2014). It might therefore be primarily in a woman's later adulthood where negotiation of being and *sounding* attractive and youthful might come to the fore more vigorously, and this might be what underlines the patterns observed in our data. While this may be seen as purely social, the inevitability of our ageing bodies necessarily enters the picture as we have to ask what motivates the reasons for any speaker to sound more youthful.

Furthermore, it is common, especially among singers (Sataloff, Lawrence, and Hawkshaw 1994; Lindholm et al. 1997), for women to undergo Hormone Replacement Therapy (HRT), which among other things prevents a person's pitch levels from lowering, and Madonna has been claimed to prefer 'bio-identical hormone replacement therapy' (The Marion Gluck Clinic 2022). We cannot rule out that Madonna's higher pitch values following 2013 (i.e., higher for the post-menopausal stage of a woman's lifespan) may be due to HRT. This being the case, it is likely that the changes observed in 2013 and following 2013 present a combination of biological as well as social aspects of ageing.

Although normatively attractive female voices are associated with higher f_0 , voices of *non*-normatively attractive female speakers of

American English are associated with lower pitch levels. This pattern corresponds to Madonna's speaking levels in f_0 in the 1980s and the 1990s (see, e.g., Hejná and Eaton 2025 for analyses of breathiness and pitch in femmes fatales in American cinematography). Most of Madonna's lowest f_0 values are found in the years when she is chronologically the youngest, i.e., when non-vocal cues might index youthfulness without the need to alter one's f_0 for the same function. However, as Madonna starts facing more negative criticism about inappropriate behaviour after her forties, we also observe her f_0 rise overall. Despite these tendencies, our results also showed that Madonna's f_0 displays considerable variation over the years, which makes Madonna's voice challenging to classify in terms of age, at least based on f_0 alone.

Our reviewers raise important questions. Firstly, one reviewer suggests that recordings made in the 1980s are known for distorting the acoustic quality of the data. We rule the effects of this out on the grounds of observing different f_0 patterns across individual years not only in the 1980s but also in the following decades. Secondly, another reviewer asks whether variation in Madonna's training as a singer for *Evita* (1996) might contribute to the f_0 variation in her speech. We rule this out on the grounds that the variation can be better accounted for by the topics of the interviews, by the fact that the years following *Evita* do not show a sudden change, and by the fact that we are, after all, analysing Madonna's speaking f_0 and not her singing mean pitch or pitch range.

4.2 *Vocalic variation*

The overall inspection of Madonna's vowels revealed an expanding vowel space through a combination of qualitative and smaller-scale quantitative analyses. The projected size of one's vowel space has been well-documented in research on vocal attractiveness, with larger spaces associated with higher ratings of physical and/or romantic attractiveness of female voices (see, e.g., Puts et al. 2010). Importantly, more attractive voices are also perceived as more youthful (Babel et al. 2014: 6), and speakers can manipulate the projected size of their vowel space for social purposes (Habekost et al. 2024). We propose that the expansion of Madonna's vowel space is linked with a projection of a more attractive and a more youthful persona. However, although our inspection reveals an expansion of Madonna's vowel spaces from the 1980s to the 1990s, it is not clear why this takes place at this specific stage of her life, especially

in light of our discussion of Madonna's changing f_0 . More nuanced analyses, ideally those employing Vowel Formant Dispersion, might shed more light on the matter, and it needs to be borne in mind that only a set of the entire vowel system is analysed in the study presented here. Nevertheless, the vowel space changes cannot be accounted for by biological factors, as these would result in overall gradual lowering of both F1 and F2, moving all vowels further back on the vowel space and higher up.

As was the case with f_0 , Madonna's individual vowel phoneme changes seem less tied in with biological ageing. If physiological factors were at play, the F1 of her vowels should lower over time, and in particular when her pitch also lowers. Instead, however, we see F1 *rising* between the 1980s and the 1990s, after which it lowers and remains constant during the 2000s and 2010+, although here the lowering does not reach the very lowest values associated with the 1980s. This means that these changes do not mirror those in f_0 . Furthermore, the changes affecting F1 do not affect all vowel phonemes in the same directions. As with F1, F2 values could be hypothesised to lower over time if due to biological factors. This is not what we see, however. Thus, the changes we see in Madonna's vowels are likely not due to the effects of biological ageing.

Returning to our hypotheses linked with the locales where Madonna has resided in the course of her lifespan, on the whole we see limited participation in some of the global vowel changes. In the case of the vowels in KIT and DRESS, the higher F1 values (and thus lower vowel articulations) are in line with the Front Short Vowel Lowering shown to take place on a global scale (see, e.g., Hickey 2018). However, in Madonna's speech this lowering takes place in the 1990s for TRAP and DRESS and not in the other decades analysed here. It is only KIT that shows lowering (in the 2000s) and *remains* lowered. We also saw that TRAP does not show retraction, which is what is associated with younger speakers of many English dialects. Finally, we also hypothesised that traces of the COT-CAUGHT merger would be associated with performing a more youthful persona, as the merger presents another current change in progress (Boberg 2019). While the two vowels remain distinct, we also observe a trend for the two to become slightly less distance across the years, despite the overall expanding vowel space. Her continued, if attenuating, distinction between these two vowels thus appears to be phonological in nature, especially given her later residence in an area

where the COT-CAUGHT merger is a vigorous part of the linguistic landscape.

It seems that Madonna, therefore, is adopting non-localised vowel pronunciations, but to a limited extent, and seems to be resisting at least some local pronunciations which would be expected for her age. This falls counter to at least some reports on mobile second dialect learners (Nycz 2015), which tend to adopt salient variation in their new dialect areas. It may be the case that the pressures of her performer identity are stronger than those of local, geographically-defined communities. An example of such pressures is shown in Mohamed and Winn (2025), which presents a case study of Taylor Swift's vowel changes from 2008–2019. Here, the authors discover some vowel changes over time which seem to be linked to Taylor Swift's changing places of residence, but which, importantly, also fall in line with her different musical styles and personas (Southern US English and country music, NYCE and pop music). In Madonna's case, we do not observe the presence of the more local NYCE or Northern Cities Shift features, other than the separation of COT and CAUGHT. The slightly decreased distance between LOT and THOUGHT can in addition be interpreted in terms of region rather than age: it might be the case that it serves as a way to enhance one's perceived affiliation with American English, something that is not unreasonable to expect after Madonna relocated to the UK and Lisbon.

We propose that, taken together, Madonna's pronunciation of the vowels examined here seems to be non-localised and not age-specific. This seems reasonable considering that Madonna's audience (in the sense of Bell 1989) is a very diverse, multi-dialectal one. From a sociolinguistic point of view, this means that Madonna is not behaving like the rest of her generation, nor is she behaving like a younger version of herself, and her linguistic patterns do not reflect those of younger generations either. Madonna's vowel pronunciation is fluid in that it is evolving differently both from her own, earlier speech and that of younger generations.

4.3 Performing youthfulness

At the outset of this study, we posed the following questions: 1. Does Madonna employ vocal changes to perform youth, attractiveness, maturity, or to transcend the boundaries of age? 2. More specifically, do Madonna's f_0 and/or F1 and F2 pattern as expected from a. typical changes

to her physiology, b. relevant dialectal changes associated with her generation, c. changes in her musical persona?

None of the changes observed can be satisfactorily explained by direct effects of ageing on speech production. We have seen that Madonna's vowel-specific production is difficult to classify in terms of generations and dialectal changes associated with the locales of Madonna's residences, although a slight trend to participate in changes that could be labelled as 'non-elderly' was observed. Instead, Madonna performs attractiveness throughout her career (and indeed she sees herself as a very sexual being, as mentioned in the interviews analysed here). This can be seen through the expansion of her vowel space as well as the rise in her f_0 . Attractiveness is nevertheless crucially linked to youthfulness. Thus, while performing attractiveness, Madonna—to a large extent unavoidably—also performs youthfulness.

The linguistic patterns reported in this paper mesh fairly well with the changes in her musical persona as well. For instance, two of the interviews from the 1990s on which the analyses rely were conducted during the promotion of Madonna's album *Erotica* and coffee book *Sex*, and during the *Girly Show World Tour*. These were heavily sexualised, as was her Mistress Dita persona, and she received heavy criticism for events such as rubbing the Puerto Rican flag between her legs while dressed as a dominatrix (Flores 2000: 45) and for her interview with David Letterman in 1994, which is part of the data considered here, and where she among other things asked Letterman to smell her panties. Although Madonna has always been undoubtedly non-normative, it has been in the most recent decade analysed here that she has very *explicitly* embraced the process of reinventing herself. For example, two of the interviews from 2010+ took place simultaneously with the releases of Madonna's two albums *MDNA* and *Rebel Heart*. For the latter, she developed the alias Madame X, a spy persona who changes roles and faces every day. A brief visual analysis of her Instagram account (Madonna 2019) also suggests increased explicitness of her age-non-normative behaviour, and there is no shortage of those who speculate online on Madonna's plastic surgeries over the past 20 years.

In conclusion, in terms of her speech (as well as other aspects of her life), Madonna is not behaving as we might expect according to her chronological age—thus following a general trend for age personas to diversify outside norms traditionally associated with their life stages:

‘[e]xpected behaviours associated with ageing can no longer be taken for granted’ (Biggs 2005: S118). These findings potentially present a challenge to the premise of apparent-time studies, which assume that individuals’ speech does not change after a certain point in their early years (see Wagner 2012 for an overview). In other words, ageing does not lead to a loss of agency. By challenging normative speech-related behaviour, Madonna arguably transcends the boundaries of age.

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Appendix

The [Supplementary materials](#) are available here.