

ABSOLUTE TEMPO IN MULTIPLE PERFORMANCES OF ABORIGINAL SONGS: ANALYZING RECORDINGS OF *DJANBA 12* AND *DJANBA 14*

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SONGS THAT ARE NOT NOTATED BUT TRANSMITTED through live performance are of particular interest for the psychological study of the stability of tempo across multiple performances. While experimental research points to highly accurate memory for the tempi of well-known recorded music, this study asks whether there is any evidence of *absolute tempo* in a performance tradition that does not draw on such reference recordings. Fifty-four field recordings of performances of one Aboriginal dance-song, *Djanba 14*, were analyzed. Results showed that over a span of 34 years, performance tempi deviated positively or negatively, on average, by 2%. Such small tempo variation is similar to JND thresholds to discriminate the tempi of isochronous sequences. Thirty-five field recordings of another song from the same repertory, *Djanba 12*, deviated in tempi by an average of 3%. We discuss the musical, psychological, physical, and cultural factors likely to shape such temporal stability.

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There is an increasing body of evidence suggesting that accurate long-term memory for tempo in music is widespread. Infants remember the tempo of melodies they have heard repeatedly (Trainor, Wu, & Tsang, 2004), and when asked to sing back popular songs from memory, adults produce a tempo that is close to that of the original commercial recording (Levitin & Cook, 1996). Brennan (2007) found that nonmusicians were as accurate as musicians ($M = 8.47$ years of music training) in correctly identifying the original Nokia Tune (V.3) ring-tone from a version which was altered in tempo by 10%. Correct identification of the original

tempo was in the order of 82-85%, suggesting that the altered tempo is clearly recognized as different from the highly familiar original, and that the public at large is expert in tempo memory for music to which they are frequently exposed in one standard form. The reliability of our long-term memory for the tempo of music known in a fixed form is perhaps not surprising. Recordings allow for repeated exposure to music at precisely the same tempo, and this exact repetition would lend itself to a veridical representation. Moreover, fixed recordings allow reliable associations to be made between the temporal structure of the music and other aspects of its content. For example, the precise onset and duration of a particular pitch, timbre and intensity can be learned. But how accurate is long-term memory for the tempo of music that is not known in a fixed form? In the current paper, we investigate this question by an analysis of multiple field recordings of two particular Aboriginal dance-songs, selected because they are performed in the context of an oral music tradition in which neither a fixed recording nor musical score are drawn upon for reference.

An important debate in the psychological literature asks how we perceive and represent different dimensions of sound in speech and music, from infancy through to late adulthood. The debate centers on the balance of absolute to relative information in our cognition of sonic features such as pitch relations and voice recognition. Adults often discard absolute information such as exact pitch height in order to recognize the relative attributes of a familiar melody (transposed) or a familiar word (spoken by different speakers) (Levitin & Cook, 1996). The necessary structural information in the sound has been abstracted, discarding surface features such as absolute timing information. Nevertheless, surface acoustic properties remain important in speaker identification (Mullennix et al., 2010; Yarmey, 1991), and can be important to our experience of music. Trainor et al. (2004) found that after a week of exposure to novel melodies, infants were able to discriminate those presented at the original tempo from versions played 25% faster or slower. Tempo stability in music is also illustrated by a study of the tempi of infant-directed songs (Bergeson & Trehub, 2002). When mothers were asked to sing a song they

would typically sing to their infant, the tempo deviated by 3.1% across the period of one week. By contrast, spoken utterances that were also repeated a week later varied considerably in tempo, with a deviation of 20.2%.

Perhaps tempo is an integral component of our mental image for familiar music. Halpern (1988) asked experiment participants to imagine music and to set a metronome to indicate the tempo of their musical image, repeating the exercise several days later. She found strong stability in individual tempo choice for the imagined music, arguing that tempo might be intrinsic to the way in which individuals represent song. However, there is evidence to suggest that the timing of imagined musical sequences is less reliable than other musical parameters. Janata & Paroo (2006) found that “images in time are more susceptible to distortion in the absence of external stimuli than are pitch images” (p. 842). Their experimental tasks required participants to judge the timing or pitch of a probe note in the context of an imagined scale. Since participants were asked to refrain from tapping in any way, the authors hypothesized that relatively poor performance on the timing task was exacerbated by a lack of sensorimotor engagement (even though participants might have had a motor component to their image).

Sensorimotor engagement is required in music production, and in such cases, the ability to accurately reproduce tempi has been described as *absolute tempo* (e.g., Lapidaki, 2000). This phenomenon is thought of as analogous to the production of absolute pitch, whereby an individual is able to accurately reproduce the original pitch of music without the need for an external cue (such as sounding the desired pitch on an instrument). But just how accurate must the production be, or how narrow is the window of permissible variation, in order to be defined as absolute tempo? A stringent criterion would state that consecutive tempo judgments or productions should not vary perceptibly in tempo (see below). A related criterion is adopted by Levitin and Cook (1996), who reported evidence of accurate memory for the tempo of pop songs by participants who were asked to sing favorite songs. An analysis of their singing revealed that it was on average within 8% of the actual tempo of the commercial recording (with the tempi of the recordings selected in the study spanning over 110 bpm). The authors compared their finding with the range of published just noticeable difference (JND) thresholds for tempo discrimination, arguing that the majority of the participants in their study, who were not selected with regard to music training, were recalling the tempo of songs below the limits of perceivable tempo variation. However, in making this claim, they cited JNDs for the discrimination of the duration of single intervals.

Thresholds are lower for the discrimination of longer temporal sequences (Michon, 1964; Miller & McAuley, 2005). When listeners were required to judge the relative tempo of pairs of isochronous sequences, McAuley and Kidd (1998) found a mean threshold of 2.4% (Experiment 1). JNDs for the tempo discrimination of multiple-interval isochronous sequences (akin to a musical beat) have been reported at 2.5% (Friberg & Sundberg, 1995). Accordingly, the current study will consider tempo in musical sequences to be absolute when it varies by no more than perceptible levels of 2.5%.

An ecologically valid method of studying performance tempo is to compare multiple recordings of performances of a given piece. Such an approach is adopted by Clynes and Walker (1982). They assessed the tempo of three performances of the Brahms Haydn Variations Op. 56b by Arturo Toscanini (from 1935 to 1948) and five performances of Bach’s Goldberg Variations by M. Clynes (from 1966 to 1980). Measuring overall piece duration, they found tempo variability across performances to be below perceivable levels. Another comparative study of tempo was conducted by Collier and Collier (1994), who calculated the beats per minute (bpm) of segments (ranging from 8 to 12 measures) of historical jazz recordings between 1917 and 1985, in order to discover whether jazz musicians preferred particular tempi. At most, four takes of one song could be compared, yet from this comparison the authors found some consistency in tempo. Among their other findings was a tendency for older jazz styles to collectively show a pattern of metronome markings that was normally distributed around a central tempo, while more recent styles showed less of a normal dispersion around a mean. They speculated that older styles were more closely associated with dance, and that this might have narrowed the window of temporal variation. Both Collier and Collier (1994) and Clynes and Walker (1982) studied recordings that were commercially available, and so we cannot rule out that performers who had heard the early recordings came to be influenced by their tempi in the performance of subsequent recordings. An additional concern with both studies is the small number of recordings or takes of a particular piece that could be compared. The current study aims to examine a much larger database of tokens of one same song, using field recordings from an oral tradition in order to explore tempo changes over many years.

Oral Music and Long-Term Memory

Music that is not notated but transmitted through live performance is of particular interest for the psychological study of the stability of tempo across multiple

performances. In the absence of a fixed rendition such as a recording or a metronome mark, we might expect tempi to change. On the other hand, there are many compelling arguments for consistent tempo production across multiple performances, since tempo may be integral to the distinctiveness of the individual song (Juhasz, 2002). Levitin and Cook (1996) argued that their participants retained the absolute tempi of the specific recordings to which they had been exposed. By contrast, a control experiment showed great variability in the tempo choice of folk songs not known at a fixed tempo (*Happy Birthday*, *We Wish You a Merry Christmas*, and *Row, Row, Row Your Boat*). However, this differs from the finding of tempo consistency by mothers singing to their infants (Bergeson & Trehub, 2002). Differences between these two studies might be attributed to adult- versus infant-directed communication, or perhaps the frequency of performing the song in everyday life (much higher for the mothers singing in Bergeson & Trehub, 2002). The current paper asks whether there is any evidence of absolute tempo in another oral tradition that draws on neither exemplar recordings nor a metronome mark.

Scant research has examined the stability of tempo for music in an oral tradition. An exception can be found in the work of Ellis (1984), who surveyed the total duration of different recordings of particular Aboriginal songs gathered over a period of nine years. Specifically, she analyzed Pitjantjatjara songs from central Australia, with instances of between three and six recordings of any one song. In her analysis, she found deviations in song duration ranging from 0.1 to 0.6 s, inferring the operation of a form of *perfect time*. However, measures of the tempi of these songs were not provided, and the sample of recordings was small for the scale of her suggestion that Aboriginal performers exhibit absolute tempo. The Pitjantjatjara songs feature a stick beating accompaniment that Ellis considers to be important as a time measurement device, commenting that “performers variously describe the sound of the continuous beating accompaniment as representing the bounding of a kangaroo, the beating of a heart, and the sound made by an emu” (p. 160). Moyle has stressed the importance of considering temporal relationships between sound production and the physical movements of Aboriginal dancers (Moyle, 1984). He also argues for the biological impact of breath capacity and heartbeat in determining appropriate tempo and rhythmic ratio (Moyle, 1995).

With the exception of computer-generated forms, music performance entails movement, which is intimately linked to physiological factors such as heartbeat and breath. These can all be expected to play a role in tempo production. Collier and Collier (1994) speculated

that “natural activities, such as walking, running, and dancing, are subtly constrained toward preferred frequencies” (p. 241). Their data point to distinct tempo bands around 117 bpm (slow), 160 bpm (slow-medium) and 220–230 bpm (fast). In a study of the ability to synchronize walking with musical and metronome stimuli, Styns, van Noorden, Moelants, and Leman (2007) found that participants optimally synchronized their walking at 120 bpm. The level at which one might tap a foot to the music is referred to as the *tactus*. Palmer (1997) notes a preference for a *tactus* around 600 ms (100 bpm), falling within the *optimal processing zone* (Trainor et al., 2004) based on spontaneous tapping tasks. She describes work by Fraise (1982), demonstrating an average inter-step interval of 540 ms (111 bpm) in *neutral walking*.

If there were one natural tempo that tends to fit all musical performances well, then this would account for low variability across recordings. However, it is obvious that different tempi would be required to match activities as common as running, dancing, and walking. The inclusion of text in song, and the accompaniment of dancing or procession, will limit the extremes of suitable tempo. It has been argued that rhythm serves a critical aesthetic and mnemonic function in oral music, inseparable from choice of tempo (Ellis & Barwick, 1989; Ellis, 1985). Moreover, the sheer physicality of singing or playing imposes a set of motor preferences on tempo choice. In many Australian indigenous traditions—such as the *Djanba* tradition that is the subject of this paper—the lead singer uses a pair of wooden clapsticks to provide percussive accompaniment to the singing. The clapstick beat needs to match the physical motions of the dancers, and perhaps even drive the dance along. As described below, children first learn *Djanba* by synchronizing to the clapstick beats and then through dance. Similarly for Pitjantjatjara communities, Ellis (1985) describes formal song learning by children as a process that begins with correct beating before singing the melody. Such a focus on accurate beat production would lend itself to performance knowledge as a kinesthetic representation, a form of embodied cognition (Iyer, 2002). Interestingly, research by Todd, Cousins, and Lee (2007) has demonstrated a significant relationship between individuals’ preferred tempo in perception, and their anthropometric profile. Such a link between the body and perception might well be amplified when it comes to enacting performance tempo.

Ceremonial dance-songs from the Murriny Patha-speaking people, who reside in the Wadeye area of the Northern Territory of Australia, can be grouped according to different speeds of their clapstick accompaniment. *Cautious clapsticks* (*mirn’ga pandharryit*) are at a moderate

tempo, falling between 113 and 124 bpm. *Fast clapsticks* (*min'ga pirtpirt*) can range from 129 to 150 bpm. *Dancing clapsticks* (*mirn'ga purrkpurrk*) are used for 5/8 vocal rhythms, with a lopsided clapstick beating accompaniment subdividing the vocal unit, consisting of one clapstick beat covering two quavers of the vocal rhythm and a second beat covering three quavers, with handclapping accompaniment and dancers' steps synchronized to the first, shorter, clapstick beat (the *main beat*): the main beat, the tempo of handclapping and steps, fits within the range of 77 to 94 bpm. These tempo bands are distinct from each other, but describe a broad range of acceptable tempo for performance within the band. Any discussion of tempo in such a context should distinguish between the thresholds of tempo needed to correctly identify a song for it to be judged an acceptable performance, and for it to be so accurately reproduced through time as to constitute an instance of absolute tempo.

Introducing *Djanba*

Djanba is the name of a repertory of around 100 public dance-songs created by Murriny Patha people in the Wadeye (Port Keats) area of Australia's Northern Territory. The *Djanba* repertory is relatively recent, composed by a number of known individuals in the period after 1961 for use in public ceremonial occasions such as funerals, mortuary ceremonies for the disposal of the belongings of the deceased, and boys' circumcision ceremonies. At Wadeye, *Djanba* is one of three ceremonial repertories performed on such occasions (the others are *Wangga* (Marett, 2005) and *Lirrga* (Barwick, 2003, 2006; Ford, 2006), which are owned and performed by members of different clan groups). Clapsticks are played by the song leader(s), with optional handclapping from audience members. Both men and women of the relevant clan groups, using different gender-specific styles, dance *Djanba*.

Children are taught to dance from the age of about seven, sometimes even earlier, usually supervised by a parent or other senior person. Dancers synchronize their footsteps with the percussion accompaniment, whose tempo is set by the song leader. The song leader is a senior person, usually a man who has composed his own songs to add to the repertory (if a male song leader is not present, a senior woman may lead the singing). Learning to clap along to the songs and then to dance them, are the first steps along the path of ceremonial learning. In time, young people are instructed on the cosmology that underlies the songs, including knowledge of their clan's totems and country, which are frequently referred to in the song texts. As they become

more senior, they are entrusted with more significant ceremonial roles in the dances, such as enacting specific references in the song texts, or leading the group of dancers in ceremonial actions. Only senior people who have a deep knowledge of ceremonial practice and the significance of the songs, as well as a good voice, form part of the singing group: they have all been dancers earlier in their career (for further information on music learning in traditional Aboriginal societies, see Ellis, 1985, and Moyle, 1973).

Djanba 14 is one of the most commonly performed dance-songs in the repertory. Like all *Djanba* songs, it is strophic in musical organization: the same song text is repeated with almost identical rhythm and melody a number of times (usually two, three, or four times) in the course of a single song item. In performance, the same song item is usually repeated at least once before moving on to another text. *Djanba* songs are composed in one of several rhythmic modes (the combination of clapstick tempo and vocal meter, see Barwick, 2003). *Djanba 14* is in fast, even triple rhythmic mode, with one clapstick beat falling every three quavers of the vocal rhythm (indicated by "x" in Figure 1). In the example transcribed in Figure 2, these clapstick beats are performed at the rate of 139 bpm.

Djanba 14 was composed by the song leader Lawrence Piyelam Kolumboort (1939–2006), a member of the Dimirnin clan.¹ As is usual for *Djanba* songs, the song-text is in grammatical Murriny Patha.² The song text mentions an important Dimirnin totem,³ namely *tjithay* (*honey*; known as *sugarbag* in Aboriginal English), and the important clan area named Kunybinyi. The song also refers obliquely to an important Dimirnin clan site (*nguguminggi*; *totem site*), a cave within the Kunybinyi area that is inhabited by the song-giving *Djanba* spirits. The strophic form of this text is AABCCC (see Figure 1). A musical transcription is reproduced in Figure 2.

Djanba 12 was composed by Charlie Kurawul. This song makes reference to Wadeye, and also concerns important Dimirnin totem, specifically *mandjigat* (*red-collared lorikeets*; *Trichoglossus rubritorquis*). The text and musical transcription of the rhythm appear in Figure 3. Unlike *Djanba 14*, the strophic form of *Djanba*

¹See Stanner (1989), Falkenberg (1962), and Furlan (2005) for information on clan and group relationships in the Wadeye (Port Keats) area.


²A small number of songs contain words in an unintelligible language that is attributed to spirits inhabiting Kunybinyi, one of the most important areas of Murriny Patha country. This language is called *murriny kunybinyi* (the language of Kunybinyi).



³A *totem* is a culturally significant being associated with the relevant clan and its country.




LINE A (repeated)

(aa) *yilele dangimangkardu ku tjithay mamnyedjekngarrim ngarra ma(nge) ngay wardarra-ya*

'(ah) father look at the sugarbag in my hand that I'm playing with now'

yile-le	da-ngi-ma-ngkardu
	
x x	x x




ku tjithay	mam-nyegdjek=ngarrim
	
x x	x x x

ngarra	ma(nge) ngay	wardarra-ya
		
x	x	x x x x x x

LINE B

ngurdunggarl(nu)tharra Kunybinyi wangu-ya (aa)

'I'm going to put it back over at Kunybinyi'

ngurdu-nggarl-(nu)-tharra	Kunybinyi	wangu-ya
		
x x x	x x	x x

LINE C (repeated 3 times)

ngarra ngu(wu)minggi wardarra maletetnungirraya

'where the totem site is, I'll stick it in there.'

ngarra	ngu(gu)minggi	wardarra	ma-let-et-nu-ngirra-ya
			
x	x	x x	x x x x

FIGURE 1. Text transcription and translation of *Djanba 14* by Joe Blythe, with assistance from Lawrence Kolumboort and Michael Walsh. Text rhythm transcription by Linda Barwick and Corin Bone. Syllables enclosed in brackets are omitted in the sung form of the text. The symbol "x" in the rhythmic transcription indicates the placement of the clapstick beat.

12 is structured as a repetition of the same text, four times (AAAA). The first two repeats of the text, performed by the men alone over identical matching descents, are performed unaccompanied and in rather free rhythm, with variable durations of the long note at the end of the line. The last two repetitions of the text, during which the women enter the singing, are accompanied by clapstick beating, and it is this version of the text that is transcribed in Figure 3. The rhythmic mode here is moderate duple even, where the clapsticks and handclapping from

onlookers fall every four quavers of vocal rhythm. Clapstick tempo here is approximately 115 bpm.

Djanba Recordings and Tempo Measurement

Fifty-four performances of *Djanba 14*, spanning a period of 34 years (1968–2002), and 35 performances of *Djanba 12*, spanning a period of eight years (1997–2005), were analyzed for tempo. Table 1 summarizes the number of items recorded by year, place of recording, recordist,

(men) text line A

murriny (voice)

mim.ga (clapsticks)

Aa yile - le_dangimangkardu ku tji-thay mamnyegdjek - nga-rrim nga-rra ma - ngay wa-rda-rra-ya

mu

text line A

yi - le-le da-ngi-mang-ka-rdu__ ku__tji-thay mam-nyeg-djek - nga - rrim nga-rra ma - ngay__ wa-rda-rra - ya_____ Aa

mu

text line B

text line C

(women)

ngu-rdung-garl - nu - tha-rra kuny-bi nyi wa-ngu Aa nga-rra ngu-wu-ming-gi wa-rda-rra ma - le-tet-nu-ngi-rra - ya

mu

text line C

text line C

nga-rra ngu - wu-ming-gi wardarra ma - le-tet-nu-ngi-rra - ya nga-rra ngu - wu-ming-gi wa-rdarra ma - le-tet-nu-ngi-rra-ya Aa

FIGURE 2. Musical transcription of one verse of *Djanba 14* (verse 2 of song item AF2002-11-s11). Transcription by Linda Barwick and Corin Bone, 2007.

performance occasion, and lead singer for *Djanba 14*. Table 2 summarizes the same data for *Djanba 12*.

Since the corpus is based on recordings of variable quality, a question may arise as to the reliability of the tempo

information in the digital recordings. Wherever possible we have digitized from the original recordings, using archival-quality equipment. Other items are cassette copies of an unknown number of generations, and

LINE A (repeated four times)

*kardu djanba djanba numidharru wurdanthuk ngakumarl mandjigat yingamyerrardim
Wadeye wardarraya*

'Djanba man, he sent one Djanba on his own to where the totems, red-collared lorikeets (*Trichoglossus rubritorquis*), were already flying around together at Wadeye.'

kardu	djanba	djanba	numidharru	wurdan-thuk
x	x	x	x	x

ngakumarl	mandjigat	yingam-yerrarr-dim	Wadeye	wardarra-ya
x	x	x x	x	x x

FIGURE 3. Text transcription and translation of *Djanba 12* by Joe Blythe, with assistance from Elizabeth Cumaiyi and Michael Walsh. Text rhythm transcription by Linda Barwick and Corin Bone. Syllables enclosed in brackets are omitted in the sung form of the text. The symbol 'x' in the rhythmic transcription indicates the placement of the clapstick beat.

TABLE 1. Recordings of *Djanba 14* by Year, Place of Recording, Recordist, Occasion, and Lead Singer.

Year	Place	Recordist	Occasion	Lead singer	Items
1968	Kununurra	A. Moyle	Elicited dance performance	Pannikin Manbi	3
1986	Wadeye	V. Roche	Circumcision	Lawrence Kolumboort	3
1986	Wadeye	C. Street	Impromptu/ non-ceremonial	Lawrence Kolumboort	2
1988	Wadeye	Marett	Circumcision	Lawrence Kolumboort	13
1988	Nadirri	Marett	Rag burning	Kevin Bunduck	2
1990	Wadeye	Unknown	Circumcision	Lawrence Kolumboort	2
1992	Wadeye	Enilane	Circumcision	Kevin Bunduck	1
1992	Wadeye	Enilane	Circumcision	Lawrence Kolumboort	2
1997	Wadeye	Marett	Elicited performance	Lawrence Kolumboort	1
1997	Wadeye	Marett	Circumcision	Lawrence Kolumboort	2
1998	Wadeye	Marett	Funeral	Lawrence Kolumboort	6
1998	Merrepen	Marett	Rag burning	Lawrence Kolumboort	4
1998	Peppimenarti	Marett	Bravery award	Lawrence Kolumboort	2
2001	Kuy	Marett & Barwick	Rag burning	Lawrence Kolumboort	4
2002	Unknown	Furlan	Unknown	Lawrence Kolumboort	2
2002	Wadeye	Furlan	Funeral	Lawrence Kolumboort	2
2002	Emu Point	Furlan	Rag burning	Lawrence Kolumboort	3

Note: See Appendix for more information about specific recordings.

clearly the reliability of such recordings is more questionable. As a matter of interest, Barwick (see footnote 4) has identified a duration difference of only 0.015% between two generations of cassette tape recording of the same item.⁴ Nevertheless, in the Appendix we have given a subjective assessment of confidence in the reliability of the tempo information in our corpus, based on the known provenance of the digital files that were used for measuring tempo. Most of the items analyzed are considered to be reliable since the limited processing they have undergone, such as digitizing of the original recording, has been well documented. However, the reliability of all the recordings cannot be guaranteed.

A number of different forms of tempo stability were of interest, namely tempo stability during a performance, an individual performer's stability of tempo choice for the song, and song tempo stability across a period of many

years. Tempo was measured for the duration of each available recording of *Djanba 14*. Tempo measurements of *Djanba 12* were partial, based on the clapstick portions of the performance. Each audible clapstick was marked by hand in *Transcribe! Version 7*, and an arithmetic mean tempo in bpm was automatically calculated by dividing the duration of the excerpt by the number of marked clapsticks. Not all recordings are three verses long, and some are missing sections of verse, meaning that global tempo measures per recording are based on different length items. To help circumvent this issue, mean tempo per verse was also calculated. These data also form the basis for tempo comparisons across performance. Knowledge of tempo fluctuation across performance is informative in its own right, but can also help to establish normal variability within one same performance, to be used in turn to define a range of tempi considered to be acceptable.

Results

Mean Tempi

Djanba 14. The mean tempo of the 54 recordings was 141 bpm, ranging from 127 to 148. Thus, *Djanba 14* is an example of fast clapsticks. These data are presented in Figure 4. However, the reliability of the recording at 127 bpm was questionable (see Appendix, item 7A),

⁴The recording in question is number 7B in the Appendix—the version used in this paper was digitized from Enilane's master cassette tape using archival quality equipment, while another cassette copy (of an unknown number of generations of copying from the master) was found in the sound archives of the Wadeye Aboriginal Languages Centre, and digitized by Allan Marett in 2001 using consumer-quality tape deck. Comparison of the absolute duration of the song recordings shows that the digital recording derived from the master tape, at 1'49.87 s is 0.16 s longer than the digital sound-file derived from the cassette copy (1'49.71").

TABLE 2. Recordings of *Djanba 12* by Year, Place of Recording, Recordist, Occasion, and Lead Singer.

Year	Place	Recordist	Occasion	Lead singer	Items
1997	??	Crocombe	Elicited performance	Lawrence Kolumboort	1
1998	Merrepen	Marett	Rag burning	Lawrence Kolumboort	5
1998	Merrepen	Marett	Rag burning	Felix Bunduck	1
1998	Wadeye	Marett	Funeral	Lawrence Kolumboort	5
1998	Wadeye	Marett	Funeral	Felix Bunduck	1
2001	Kuy	Marett & Barwick	Rag burning	Lawrence Kolumboort	5
2002	Merrepen	Furlan	Funeral	Lawrence Kolumboort	4
2002	Unknown	Furlan	Unknown	Lawrence Kolumboort	2
2002	Wadeye	Furlan	Rag burning	Lawrence Kolumboort	2
2002	Wadeye	Furlan	Funeral	Lawrence Kolumboort	2
2002	Wadeye	Furlan	Funeral	Felix Bunduck	2
2003	Wadeye	Crocombe	Circumcision	Elizabeth Cumaiyi	1
2003	Wadeye	Crocombe	Circumcision	Lawrence Kolumboort	1
2003	Wadeye	Crocombe	Circumcision	Felix Bunduck	2
2005	Wadeye	Blythe	Funeral	Lawrence Kolumboort	1

Note: See Appendix for more information about specific recordings.

since the recordist was unknown, as was the number of generations of tape copying of the song before digitization of the item. On the basis of an exceptionally poor estimate of the tempo information of this recording relative to the others, this recording was excluded from the analyses, leaving a standard deviation from the mean (still 141 bpm) of 3 bpm. Interpreting the mean tempo of 141 bpm as a consensus of ideal tempo, 3 bpm represents 2.1% from the ideal, meaning that performance tempi deviated positively or negatively, on the average, by only 2%.

Three performances of *Djanba 14* recorded at a rag burning ceremony at Merrepen deserve special mention. The tempi were 146, 147, and 148 bpm, at the high end of the recorded tempo range. In fact, these three performances occurred at the end of a long ceremony, and analysis of the video footage showed an evident rush to end the proceedings, perhaps impacting on the choice of a faster tempo than usual.

Djanba 12. The mean tempo of the 35 recordings was 116 bpm, ranging from 107 to 124. Thus, *Djanba 12* is an example of cautious clapsticks. These data are presented in Figure 5.

Djanba 12 is not systematically danced to, and in this figure, performances have been split according to whether there was dancing or not. Considering all performances, irrespective of dance, the standard deviation from the mean was 4 bpm, representing an average tempo deviation of 3%. Performances without dance had a mean tempo of 115 bpm, and a standard deviation of only 2 bpm (2%). Danced performances were faster

on average, with a mean tempo of 118 bpm, and a greater standard deviation of 5 bpm (4%).

Tempo Across the Years

In order to assess the stability of tempo in *Djanba 14* through time, Figure 6 graphically represents the mean tempo of each performance by year of recording, excluding the 127 bpm outlier. While the data were limited by an uneven number of recordings per year, a trend line illustrated no particular speeding up or slowing down across the period: correlation of year of recording with mean bpm showed no significant relationship, $r(51) = -.06$, $p > .05$.

Performances of *Djanba 12* only span eight years. It was therefore not surprising that no discernible trend was apparent for this song, $r(33) = -.01$, $p > .05$.

Tempo by Performer and Occasion

The dataset did not allow for a systematic comparison of the tempo choice of different performers, as Lawrence Kolumboort led 48 of the 54 performances of *Djanba 14*, and 28 of the 35 performances of *Djanba 12*. The tempo range ($M = 141$, 134–148 bpm) of *Djanba 14* performances led by him spans the entire range of tempi in our analysis. Pannikin Manbi only led three performances ($M = 139$, 137–140 bpm), as did Kevin Bunduck ($M = 141$, 127⁵–141 bpm). The *Djanba 12* performances led by

⁵The recording at 127 bpm has been excluded from analysis as an outlier.

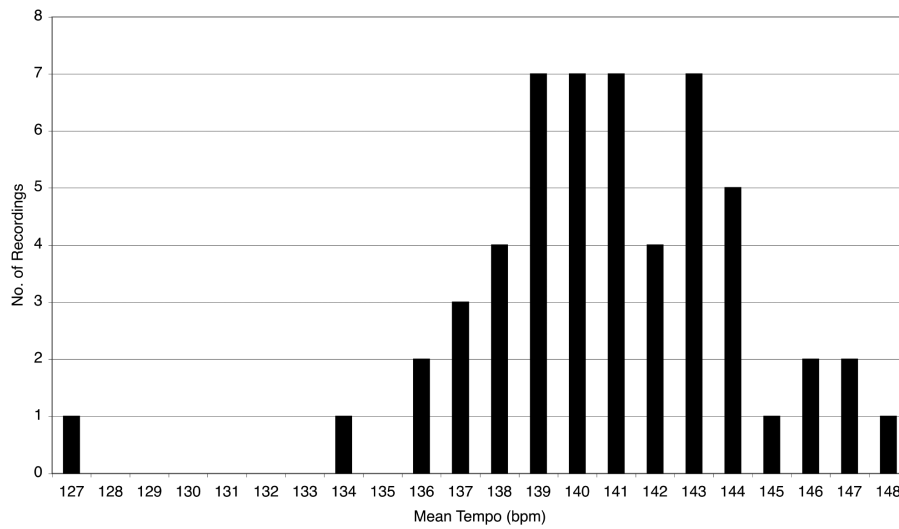


FIGURE 4. Mean beats per minute (bpm) of the 54 recordings of *Djanba 14*.

Lawrence Kolumboort ($M = 117$, 111–124 bpm) are faster than the tempo set by Elizabeth Cumaiyi (107 bpm) and Felix Bunduck ($M = 115$, 110–121 bpm). An uneven sample of recordings from different types of performance prohibits a statistical comparison of tempo by occasion.

Tempo within Performance

Beats per minute for each verse of each performance were entered into analyses of tempo variation from verse to verse. Since recordings differed in the number of intact verses available for analysis, it was important to

examine any relationship between number of verses and tempo change. In *Djanba 14*, change in tempo across song was not a function of the number of verses analyzed: a correlation between the number of verses and the standard deviation of tempo across verses (in bpm) was not significant, $r(51) = .20, p > .05$. However, the longer the performance of *Djanba 12*, the greater the variability in tempo, $r(33) = .33, p < .05$.

There was no overall tendency for the tempo to decrease or increase for either song. An increase in tempo would be indicated by greater bpm for later verses, and a decrease in tempo would be indicated by a lower bpm

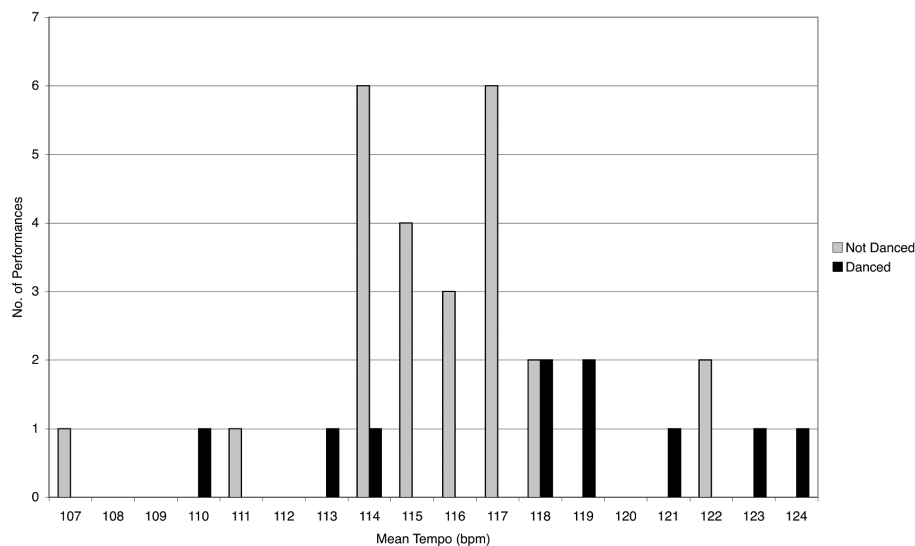


FIGURE 5. Mean beats per minute (bpm) of the 35 recordings of *Djanba 12*.

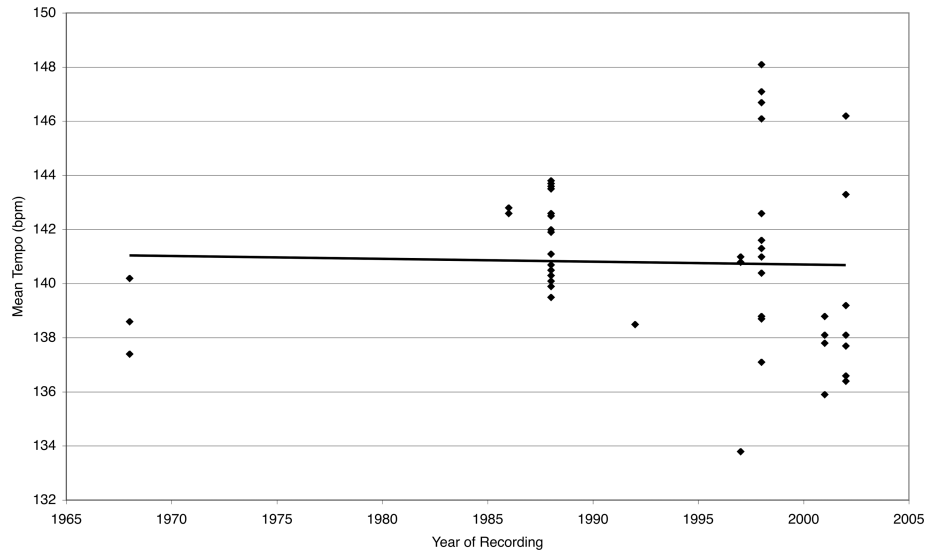


FIGURE 6. Mean tempo of each *Djanba 14* performance by year of recording. The outlier at 127 bpm has been excluded, and a regression line illustrates the stability of the mean through time.

for later verses. Table 3 summarizes the mean bpm by verse, for each of the *Djanba*. No significant correlation between the mean tempo per verse and its position in the song was found, $r(162) = -.06, p > .05$ for *Djanba 14* and $r(113) = -.00, p > .05$ for *Djanba 12*. In *Djanba 14*, 12 of the recordings showed no change in tempo from verse to verse. Three performances sped up and then slowed down, while four slowed down and then sped up. Most performances slowed down ($n = 24$) by between 1 and 4 bpm. Ten performances sped up by between 1 and 3 bpm. We have already asserted that a suitable measure for acceptable tempo variation across performances is the degree of variation that naturally occurs during a performance. The largest difference between verse tempi is greater than the standard deviation in tempo between recordings described above. In *Djanba 12*, only four of

the recordings stayed at the same mean tempo per verse. Five performances sped up and then slowed down, while six slowed down and then sped up. Eleven performances sped up by between 1 and 3 bpm, while nine performances slowed down by 1 to 2 bpm. For each performance, a measure of trend was calculated, being the correlation of tempo per verse with verse number (i.e., position in the song). A subsequent correlation of mean tempo with trend per recording revealed no tendency for slow songs to speed up, or for fast songs to slow down, *Djanba 14*: $r(51) = .04, p > .05$ and *Djanba 12*: $r(33) = .04, p > .05$.

Djanba are sung at many different moments within a ceremony. It would be natural for the lead singer to be influenced by the tempo of the immediately preceding song (Jones & McAuley, 2005; McAuley & Miller, 2007). This contextual information was available for ten of the *Djanba 14* recordings. Five performances succeeded another fast song ($M = 141$, range 138–144 bpm), while five succeeded a moderate song ($M = 139$, range 136–141 bpm). The difference between these performance groups was not statistically significant, $t(8) = 1.53, p = .08$, but is suggestive of a pattern in which context impacts on tempo choice. Not enough contextual information for *Djanba 12* was available to make any meaningful comparison.

Discussion

Results show little variation in the performance tempo of *Djanba 14* across a span of 34 years ($SD = 2\%$).

TABLE 3. Mean (*M*) and Standard Deviation (*SD*) bpm per Verse, Collapsed Across Performances for Each *Djanba*.

Verse number	<i>Djanba 12</i>			<i>Djanba 14</i>		
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>
1	116.2	3.6	35	141.1	3.6	53
2	116.3	3.6	35	140.8	3.4	53
3	116.4	3.7	33	140.7	3.5	48
4	116.2	4.8	8	139.2	4.9	9
5	114.7	5.0	3	145.0	N/A	1
6	117.0	N/A	1	/	/	/

Note: The number of each verse recorded and available for analysis is indicated (*n*).

Recordings of *Djanba 12* span a relatively shorter period, but they also vary little over time ($SD = 3\%$) and importantly demonstrate stability around a quite different mean tempo compared to *Djanba 14*. In order to be considered an instance of absolute tempo, we have argued that performances should vary in tempo on average by no more than perceptible levels, defined by a JND threshold of 2.5%. Performances of *Djanba 14* meet this conservative criterion, while performances of *Djanba 12* come close, and those performances of *Djanba 12* that were not danced ($SD = 2\%$) correspond to our definition of absolute tempo. While the same individual led most performances, such invariance is remarkable in the face of the numerous factors that are likely to modulate both choice of tempo and its stability through time. Tempo during the performances was also surprisingly consistent across verses, with a maximum deviation of 4 bpm. The most common tendency in *Djanba 14* however was a deceleration across verses. There is evidence to suggest that listeners show a bias to perceive acceleration at tempi greater than 100 bpm (Quinn & Watt, 2006). A tendency to slow down in *Djanba 14* may be a response by the performers to their perception of acceleration. Such an effect would be less marked in the slower paced *Djanba 12*.

To illustrate why such tempo stability is surprising in an oral musical tradition, we begin by discussing a range of factors that would seem to militate against it. For example, the central role of dance in *Djanba* is an obvious constraint on the range of performable tempi, but analyses of *Djanba 12* suggest that tempo is stable even in performances without accompanying dance. Perhaps having learned the song initially through movement is sufficient for the kinesthetic image to remain even in the absence of the dance. The slow tempo band around 117 bpm described by Collier and Collier (1994) seems to align with the mean tempo of *Djanba 12*, but none of their bands can account for the mean tempo of *Djanba 14*. Moreover, the average interval between clapsticks in *Djanba 12* and *Djanba 14* is shorter than the average interstep interval of 540 ms articulated by Palmer (1997), at 517 ms and 426 ms respectively.

The lead singer is not in isolation when he selects a performance tempo: fellow singers, dancers, and spectators who play a part in the performance surround him (see Figure 7). Collier and Collier (1994) observe that group performance is inherently complex, combining the explicit selection of tempo before starting to play, as well as an implicit “tug of war among the musicians that



FIGURE 7. Surrounded by other singers and dancers, *Djanba* composer Lawrence Kolumboort dances *Djanba* at a ragburning ceremony in 1998. In this case he is not playing clapsticks as he dances, but is holding them as a sign of his ritual authority. His backup singer Felix Bunduck, on the left, plays clapsticks and leads the singing. Photograph by Mark Crocombe, Wadeye Aboriginal Languages Centre.

might adjust the tempo during the performance. Perhaps this interactive process obscures individual musicians' preferences" (p. 228). Similar processes might be expected to operate in the ceremonial performance of *Djanba*, where interaction between the singers and dancers adds a further dimension to the feedback loop. What is remarkable, however, is that in *Djanba* the song leader (most commonly Lawrence Kolumboort) sets the tempo before any dancing begins and before other musicians join him, requiring an accurate memory of the beat to avoid going either too fast or too slow. In this respect, there are clear similarities with a conductor's role in setting the tempo in Western music traditions. Those performers who lead the singing of performances of *Djanba* are senior community members. Older experiment participants have been found to spontaneously select slower motor tempi than younger participants (Baudouin, Vanneste, Isingrini, & Pouthas, 2006). However, as Lawrence Kolumboort aged across the 34-year period of *Djanba 14* recordings, there is no evidence of a slowing down in the tempo of his performances.

It seems likely that the tempo of a *Djanba* performance will be influenced by its musical context. For instance, it seems likely that a performance during the preparations for a ceremony would be less intense, and consequently slower, than its performance at the height of a ceremony. Lapidaki (2000) found that when participants were asked to set their preferred tempi, the initial tempo at which the music was presented influenced the final tempo selection. Contrary to this, Quinn and Watt (2006) found that listeners selected tempi regardless of listening context. For those recordings of *Djanba 14* where information about the immediate performance context was available, we found a tendency for performances preceded by slower songs (moderate clapsticks) to be at a slightly slower tempo than performances preceded by faster songs, although the difference was not significant.

In Western classical music there is a clear association between emotional expression and tempo, with happy and angry emotions associated with faster tempi compared to soft and sad emotions (Palmer, 1997; Quinn & Watt, 2006). In the Daly region of the Northern Territory, Marett (2005) has discussed how the *Wangga* singer Tommy Barrantjap uses the term *lerri* (happy) to describe songs in fast rhythmic mode. However, an argument against the blanket influence of mood and environmental factors on tempo preference is suggested by Lapidaki (2000). She reports a finding of absolute tempo for some individuals with some pieces, regardless of their psychological state. The *Djanba* performances come from ceremonies ranging from rag burning for deceased relatives

to coming of age initiation. Emotions presumably range from grief to joy for those most closely affected by the occasion. In *Djanba*, performers are typically from a different group than the people for whom the ceremony is being performed, so it is difficult to assess the extent to which the occasion might affect performers' state of mind. Nevertheless, it seems unlikely that the mood would be similar across all performance occasions, or that tempo memory would be enhanced by mood congruence (Bergeson & Trehub, 2002).

It seems surprising that tempo should vary so little in performances of *Djanba* given the potential pull toward a tactus, the possible influence of emotional context, the tempi of preceding performances, effects of aging on tempo preference, and, in *Djanba 12*, the frequent lack of danced accompaniment (i.e., physical enforcement of the beat). We now speculate as to the factors that might contribute to tempo invariance in this particular oral tradition. Palmer (1997) describes research to indicate that the salience of the beat influences temporal precision in performance. Different styles of dance systematically occur at different moments of the musical structure. Specifically, the dancing is more emphatic in marking the beat when the women take over singing at the end of each verse. It is not unknown for the lead singer to dance on other occasions, in which case his physical experience of producing the beat is not confined to clapstick movements, but concerns his entire body. This surely enhances long-term memory for the song's tempo, and strong crossmodal interaction between movement and auditory encoding of musical rhythm has been demonstrated (Phillips-Silver & Trainor, 2007).

Piece-specific consistency in tempo choice is associated with familiarity and preference for musical styles (Lapidaki, 2000). As Lawrence Kolumboort composed *Djanba 14*, he could be considered the most familiar with it, and would be expected to demonstrate greater temporal consistency across recordings. However, his tempo when leading in performances of *Djanba 12* was also within a very narrow window of variability, yet he did not compose this song.

Of course, the musicians in the analyzed recordings are highly practiced in performing *Djanba*. In addition to addressing idiosyncratic tempo preference, it is also worth asking whether some individuals are more consistent in reproducing their preferred tempo. The composer, who might be expected to draw on a stable representation of tempo, led most performances, matching two important criteria of expertise as a senior performer, as well as being a highly trained musician. Consequently, this study may say more about the tempo stability of an

individual musician across several decades, or the intransigence of a compositional idea (*Djanba 14*), than absolute tempo within a particular performance tradition. Nevertheless, with the exception of the single performance of *Djanba 12* led by Elizabeth Cumaiyi, the recordings that were led by other singers were also close to or matched the mean tempo of the song.

The emphasis placed on learning from early childhood to synchronize with a clapstick beat, and later dance to *Djanba*, highlights the importance of tempo in these ritual songs. Further indication of the ritual significance of tempo can be found in the banding of the corpus into discrete tempo ranges. There is a tendency for *Djanba* of different tempi to be ordered across the course of a ceremony so that faster songs coincide with the most intense moments. Accordingly, it seems that a song's thematic content, ceremonial significance, and tempo are closely linked. It could be that this association renders performance tempo remarkably stable, particularly compared to Western music traditions. For example, recall that Levitin and Cook (1996) found great variability in the tempo production of Western folk songs such as *Happy Birthday* (though it should be remembered that their experiment compared the tempo production of many different participants while the current study mainly concerns the tempo stability of the same musicians). It remains to be seen whether particular musical features or linguistic references to country, people, and totems are systematically associated with specific tempi. Future analyses might also investigate possible correlations between tempo range and the complexity of verse structure. The song text may well influence performance tempo (Levitin & Cook, 1996). As in poetic structure, the vocal rhythm bears upon the production and perception of a pulse (Clynes & Walker, 1982). Future work might contrast the text structure of songs accompanied by moderate clapsticks such as *Djanba 12*, with that of songs accompanied by fast clapsticks such as *Djanba 14*.

Physiological, stress, and age-related factors might be expected to have a direct effect on tempo stability in a straightforward tapping task, but it has been argued that the very presence of a musical context constrains and stabilizes tempo, as would appear to be the case in the analyzed recordings of *Djanba 14* and *Djanba 12*. Structural coherence has been found to affect memory for tempo: coherent events such as those that typify music (e.g., metrical patterns or melodic phrasing), are associated with a more accurate recall than incoherent musical events (Boltz, 1994). Music provides important contextual information to help both encode and retrieve constituent features (Bergeson & Trehub, 2002). Of course,

without the luxury of asking the musicians who sang this song to provide a control clapstick beat, we cannot be sure how influential their representation of the music was in determining performance tempo. This is an empirical question that could be addressed by further research.

Finally, both *Djanba 14* and *Djanba 12* are often danced, and it seems likely that the kinesthetic associations of performance reinforce the acuity of an embodied memory for tempo. Future crosscultural comparisons of the stability of long-term memory for tempo in songs with and without dance accompaniment will help to address this question. Since Lawrence Kolumboort also happened to lead most of the performances, we have only a few recordings by the other lead singers against which to compare his tempo range due to the limitations of archival research. However, it would be interesting to monitor trends in performance tempo as other senior community members replace the composer as lead singer. Future recordings of *Djanba* performances might thus reveal the extent to which Lawrence Kolumboort was exceptional in his tempo consistency.

This study is restricted to analyses of two dance-songs, selected for the unusually high number of extant recordings of each, with a particular focus on *Djanba 14* as it spans a long recording history. Nevertheless, a comparison of these two quite different dance-songs has revealed a remarkable tempo stability that may well be typical of ceremonial dance-song more broadly. We can conclude that *Djanba 14* is strikingly stable in tempo, both within a performance and across decades of performance. The degree of mean tempo variation of the performances is so slight as to correspond to the 2.5% JND for the tempo discrimination of isochronous sequences reported by Friberg and Sundberg (1995), and so points to the phenomenon of *absolute tempo*. Tempo variation in performances of the slower *Djanba 12* is similarly small, at just 3%. The extent to which tempo stability is a conscious goal of the *Djanba* performers is not known, and the absolute tempo in evidence in these recordings was probably shaped as much by an unconscious and embodied representation of the music as by a deliberate attempt to perform at a correct tempo.

Differing performance contexts, performers, and physical conditions in the analyzed recordings have exerted only a minimal influence, if any, on tempo. In this way, *Djanba* seems to run counter to Levitin and Cook's assertion (1996) of high variability in the recalled tempi of music for which no fixed recording is known. While their assertion was based on observed variability in tempo between different singers and our analysis primarily

concerns the performance variability of one singer, we provide strong evidence that a reference recording is not necessary in order to exhibit absolute tempo. The singers performed within a tradition of public ceremonial song where knowledge of the music was learned during live performance rather than notated score or fixed recording.

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Appendix

Notes on the Recordings

The corpus of recordings of *Djanba 12* and *Djanba 14* is derived from numerous different source recordings housed in the sound archives of the Wadeye Aboriginal Languages Centre. The identifiers for particular song items are derived from the database of the Murriny Patha Song Project (University of Sydney), which is available from the Wadeye Knowledge Centre, a branch of the Northern Territory Library.

1. Moyle 68 A2700AB AM76-78

This recording was made by Alice Moyle at Kununurra on August 25, 1968, as part of an elicited danced performance. The lead singers were Dusty Alpha and Pannikin Manbi. Further information is available in the booklet accompanying Moyle's recording *Songs from the Kimberleys* (Moyle, 1977). The recording was digitized by AIATSIS from second-generation reel-to-reel tape copy of the original field recording, and the likely reliability of the tempo information is estimated as good.

Three items (two incomplete):

Moyle-A2700A_AM76-s02 djanba 14	0:10
Moyle-A2700A_AM76-s03 djanba 14	1:01
Moyle-A2700A_AM78-s04 djanba 14	1:19
(incomplete)	

2. WAVA 225—Circumcision Ceremony

Brother Vincent Roche recorded this performance of *Djanba* at a circumcision ceremony held at Wadeye in 1986, on VHS video. Lead singers include Lawrence Kolumboort, Felix Bunduck, Kevin Bunduck, and Anna Maria Ninnal. Although the sound quality of the recording itself is very poor, the tempo information is well preserved by the video frame rate, so the reliability is estimated as good.

Three items:

WAVA225-Circumcision86-s01 djanba 14	2:21
WAVA225-Circumcision86-s02 djanba 14	1:37
WAVA225-Circumcision86-s10 djanba 14	1:15

3. *Malgarrin-Tharnpa*

This performance of an impromptu non-ceremonial performance was recorded on a poor quality tape recorder at Wadeye in November 1986 by Chester Street, and led by Lawrence Piyelam Kolumboort. Other singers include Kevin Bunduck, Polly Ngimpuk Bunduck, Rita Nangari Thawul, Gypsy Muthay Jinjair, Mary Naye Mollinjin, and Anna Maria Kidenu Ninnal. Because of the unknown quality of the tape recorder and the original tape, and the fact that the recording was digitized in 2007 from a second-generation tape, the likely reliability of the tempo information is estimated as moderate.

Two items:

MalgarrinDjanbaChester-A-07-djanba14_CD	1:53
MalgarrinDjanbaChester-A-08-djanba14_CD	1:25

4. *Marett Wadeye Circumcision Ceremony*

This performance was recorded by Allan Marett at a circumcision ceremony in Wadeye on May 17–18, 1988. Performers included Lawrence Kolumboort, Kevin Kanalda Bunduck, Rita Nangari Thawul, Anna Maria Kidenu Ninnal, Mary Naye Mollinjin and Elizabeth Karlingkuny Cumaiyi. The recording was digitized by AIATSIS from second-generation reel-to-reel tape, and the likely reliability of the tempo information is estimated as good.

Thirteen items:

Marett88-18B s02 djanba 14	1:25
Marett88-19A-s05 djanba 14	1:29
Marett88-19A-s06 djanba 14	1:28
Marett88-19A-s07 djanba 14	1:55
Marett88-21A-s04 djanba 14	1:55
Marett88-21A-s05 djanba 14	1:26
Marett88-21A-s06 djanba 14	1:29
Marett88-21B-s08 djanba 14	1:29
Marett88-21B-s09 djanba 14	1:00
Marett88-22A-s08 djanba 14	1:25
Marett88-22A-s09 djanba 14	1:25
Marett88-22B-s01 djanba 14	0:52
Marett88-24-s07 djanba 14	1:46

5. *Marett Nadirri Rag Burning Ceremony*

This performance was recorded by Allan Marett at a rag burning ceremony for the disposal of the belongings of two deceased Marri Tjevin people at Nadirri on June 19, 1988. Performers were Kevin Kanalda Bunduck and Anna Maria Kidenu Ninnal. The recording was digitized by AIATSIS from second-generation reel-to-reel tape, and the likely reliability of the tempo information is estimated as good.

Two items:

Marett88-37-24-s12 djanba 14	1:54
Marett88-37-26-s13 djanba 14	1:52

6. Recordings from the 1990 Circumcision Ceremony

The 1990 circumcision ceremony, with singing led by Lawrence Kolumboort, was recorded by a person unknown. Although the video transfer is faulty in some parts, and the general quality of the sound recording is poor, the tempo information is likely to have been well preserved.

Two items:

WAVA192_1990_1B-tr1.2bDjanba-s03 djanba 14	1:28
WAVA192_1990_1B-tr1.2bDjanba-s02 djanba 14	1:26

7. Recordings from the 1992 Circumcision Ceremony

Various people, including Michael Enilane, made recordings from the 1992 circumcision ceremony.

7A. D017 WASA Tape 15 CD16 Initiation Ceremonies

Alberto Furlan digitized this item in 2002-2003 from cassette tape D017 (= WASA tape 15, WASA CD16) in the Wadey Aboriginal Sound Archive. The voice of Kevin Bunduck can be heard on the recording. The recordist is unknown, and it is also unknown how many generations of tape copying intervened from the original recording. Accordingly, the likely reliability of the tempo information is estimated as poor.

One item:

WASA-D017B-s01 djanba 14	3:40
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7B. Enilane Master 1B 'Tharnpa' Circumcision

Michael Enilane recorded this performance led by Lawrence Kolumboort and Kevin Bunduck during the 1992 circumcision ceremonies held at Wadey. In 2003 Enilane provided Marett and Barwick with his original master cassette tapes, which were digitized by PARADISEC sound engineer Frank Davey and returned to the WASA archive. The likely reliability of the tempo information on this recording is estimated as good. Another poorer quality version of this recording is found on cassette tape D022 held in the collection of the Wadey Aboriginal Sound archive.

Two items:

Enilane-1B-s12 djanba 14	1:53
Enilane-1B-s13 djanba 14	1:24

8. WASA CD 191, Tape 569AB

This was an elicited performance recorded by Mark Crocombe in 1997; performers include Lawrence Kolumboort, Felix Yampunyi Bunduck, Gypsy Muthay Jinjair, and Elizabeth Karlingkuny Cumaiyi. Alberto Furlan digitized the recording from the original cassette tape in 2003 for the Wadey Aboriginal Sound Archive. The likely reliability of the tempo information is estimated as moderate.

Two items:

WASAtape569B-s01 djanba 12	2:02
WASAtape569A-s14 djanba 14	1:31

9. Crocombe Video—Circumcision Ceremony

A ceremonial performance over several days (May 29–31, 1997) at Wadey was recorded on VHS video by Mark Crocombe. Performers include Lawrence Kolumboort, Felix Bunduck, and others. The audio was extracted from a digitized copy of the videotape using *Final Cut Pro*. The likely reliability of the tempo information is good.

Two items:

Crocombe-1997-v01-djanba14	1:18
Crocombe-1997-v03-djanba14	1:17

10. Marett DAT98/08_9 Funeral

This performance was recorded on DAT by Allan Marett at a funeral on September 24, 1998 at Wadey. Performers include Lawrence Piyelam Kolumboort, Felix Yampunyi Bunduck, Gypsy Muthay Jinjair, and Elizabeth Karlingkuny Cumaiyi. The last two items were performed during the walk to the cemetery from the church. The original DAT recordings were transferred digitally to CD by AIATSIS (A17052) and the likely reliability of the tempo information on this recording is estimated as good.

Twelve items:

MarettDAT98-08-s39 djanba 12	1:32
MarettDAT98-08-s40 djanba 12	1:30
MarettDAT98-08-s41 djanba 12	1:30
MarettDAT98-08-s42 djanba 12	1:32
MarettDAT98-08-s43 djanba 14	1:29
MarettDAT98-08-s44 djanba 14	1:29
MarettDAT98-08-s45 djanba 14	1:28
MarettDAT98-09-s01 djanba 14	1:27
MarettDAT98-09-s12 djanba 12	1:29
MarettDAT98-09-s13 djanba 12	1:29
MarettDAT98-09-s33 djanba 14	1:26
MarettDAT98-09-s34 djanba 14	1:24

11. Marett DAT98/11 Merrepen Rag Burning

This performance was recorded on DAT by Allan Marett at a rag burning ceremony at Merrepen (near Peppimenarti) on September 27, 1998. Performers include Lawrence Piyelam Kolumboort, Felix Yampunyi Bunduck, Mary Diringara Bunduck, Gypsy Muthay Jinjair, Elizabeth Karlingkuny Cumaiyi, and others. There is a parallel video recording by Mark Crocombe and Allan Marett. The original DAT recording was transferred digitally to CD by AIATSIS and the likely reliability of the tempo information on this recording is estimated as good.

Ten items:

MarettDAT98-11-s04 djanba 12	1:32
MarettDAT98-11-s05 djanba 12	1:31
MarettDAT98-11-s06 djanba 12	1:29
MarettDAT98-11-s07 djanba 12	1:30
MarettDAT98-11-s13 djanba 12	2:54
MarettDAT98-11-s14 djanba 12	1:29
MarettDAT98-11-s24 djanba 14	1:23
MarettDAT98-11-s52 djanba 14	0:58
MarettDAT98-11-s53 djanba 14	1:23
MarettDAT98-11-s54 djanba 14	1:22

12. Marett DAT98/16 Peppimenarti Bravery Award

This performance was recorded on DAT by Allan Marett at a ceremony for the conferral of a bravery award at Peppimenarti on October 7, 1998. Performers included Lawrence Piyelam Kolumboort, Gypsy Muthay Jinjair, and Rita Nangari Thawul. The original DAT recording was damaged by the time it was

deposited at AIATSIS in 2005, but fortunately Linda Barwick had previously (2001) performed a digital transfer. The likely reliability of the tempo information on this recording is estimated as good.

Two items:

MarettDT98-16-s11 djanba 14	1:28
MarettDT98-16-s12 djanba 14	1:28

13. Marett-Barwick DT2001-1 Kuy Rag Burning

This performance was recorded by Allan Marett and Linda Barwick at a rag burning ceremony at Kuy, north of Wadeye, on July 9, 2001. Performers were Lawrence Piyelam Kolumboort, Felix Yampunyi Bunduck and Mary Dirringara Bunduck. There is a parallel video recording by Linda Barwick and Allan Marett. The original DAT recording was transferred digitally to CD by AIATSIS and the likely reliability of the tempo information on this recording is estimated as good.

Nine items:

MarettDT2001-1-s17 djanba 12	1:31
MarettDT2001-1-s18 djanba 12	1:29
MarettDT2001-1-s20 djanba 14	1:28
MarettDT2001-1-s21 djanba 14	1:30
MarettDT2001-1-s29 djanba 12	1:27
MarettDT2001-1-s30 djanba 12	1:28
MarettDT2001-1-s35 djanba 14	1:29
MarettDT2001-1-s36 djanba 14	1:54
MarettDT2001-1-s40 djanba 12	1:02

14. AF2002-01 Funeral

This performance was recorded by Alberto Furlan in 2002, at a funeral at Merrepen, NT. Performers include Lawrence Kolumboort, F. Bunduck, Leo Melpi, and Mary Bunduck. The original DAT recording was transferred digitally to CD by PARADISEC and the likely reliability of the tempo information on this recording is estimated as good.

Four items:

AF2002-01-s01 djanba 12	0:43
AF2002-01-s02 djanba 12	1:20
AF2002-01-s11 djanba 12	2:25
AF2002-01-s15 djanba 12	1:55

15. Furlan AF2002-11 (Event and Location Unknown)

This performance was recorded by Alberto Furlan October 8, 2002 at unknown event and location. Performers include Lawrence Piyelam Kolumboort, Leo Marru Melpi, Matthew Batjuk Pultchen, Mary Dirringara Bunduck, Elizabeth Karlinkuny Cumaiyi, and Lucy Thanggirra Tchernia. The original DAT recording was transferred digitally to CD by PARADISEC and the likely reliability of the tempo information on this recording is estimated as good.

Four items:

AF2002-11-s04 djanba 12	1:27
AF2002-11-s05 djanba 12	1:27
AF2002-11-s10 djanba 14	1:27
AF2002-11-s11 djanba 14	1:27

16. Furlan AF2002-13 Rag Burning

This performance was recorded by Alberto Furlan, October 13, 2002 at a rag burning ceremony at Wadeye. Performers include Lawrence Piyelam Kolumboort and others. The original DAT recording was transferred digitally to CD by PARADISEC and the likely reliability of the tempo information on this recording is estimated as good.

Three items:

AF2002-13-s07 djanba 12	1:22
AF2002-13-s08 djanba 12	1:22
AF2002-13-s24 djanba 14	1:22

17. Furlan AF2002-17 Funeral NT

This performance was recorded by Alberto Furlan on November 13, 2002 at a funeral ceremony at Wadeye. Performers include Lawrence Piyelam Kolumboort, Leo Marru Melpi, Felix Yampunyi Bunduck, Matthew Batjuk Pultchen, Mary Dirringara Bunduck, Theodora Narndu, and Stephen Ninnet Bunduck. The original DAT recording was transferred digitally to CD by PARADISEC and the likely reliability of the tempo information on this recording is estimated as good.

Four items:

AF2002-17-s08 djanba 12	1:51
AF2002-17-s12 djanba 12	1:27
AF2002-17-s17 djanba 14	1:24
AF2002-17-s18 djanba 14	1:22

18. Furlan AF2002-18 Rag Burning

This performance was recorded by Alberto Furlan on November 19, 2002 at a rag burning ceremony at Emu Point, NT. Performers include Lawrence Piyelam Kolumboort and others. The original DAT recording was transferred digitally to CD by PARADISEC and the likely reliability of the tempo information on this recording is estimated as good.

Three items:

AF2002-18-s19 djanba 14	1:01
AF2002-18-s20 djanba 14	1:29
AF2002-18-s21 djanba 14	1:28

19. Furlan AF2002-20 Funeral

This performance was recorded by Alberto Furlan on November 22, 2002 at a funeral at Wadeye, NT. Performers include Lawrence Kolumboort and others. The original DAT recording was transferred digitally to CD by PARADISEC and the likely reliability of the tempo information on this recording is estimated as good.

Two items:

AF2002-20-s13 djanba 12	1:51
AF2002-20-s14 djanba 12	1:15

20. MC03-08 Circumcision Ceremony

This performance was recorded by Mark Crocombe in 2003, at a circumcision ceremony at Wadeye, NT. Performers include Lawrence Kolumboort, Pius Luckan, and L. Kundjil. The

tempo reliability estimate is excellent, extracted from a digital video.

Four items:

MC03-08-s01 djanba 12	1:26
MC03-08-s12_13 djanba 12	2:01
MC03-08-s23 djanba 12	1:25
MC03-08-s24 djanba 12 mid-item	2:22

21. Blythe JB20050729-09 Funeral

This performance was recorded by Joe Blythe on July 29, 2005 at a funeral at Wadeye, NT. The tempo reliability estimate is excellent, from a digital recording.

One item:

JB20050729-09 djanba 12	1:29
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