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Shared cognitive resources between memory and attention during sound sequence encoding

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Highlights

- Attentional filtering and memory load were manipulated during sound sequence encoding
- Both manipulations impede performance in a recognition task with short melodies
- Musical training is associated with better memory but not attention skills
- Cognitive resources are shared between auditory attention and working memory
- Attentional filtering and memory encoding appear as only partly separate processes

Abstract

You are on the phone, walking in a street. This daily situation calls for selective attention, allowing to ignore surrounding irrelevant sounds, while trying to encode in memory the relevant information from the phone. Attention and memory are indeed two cognitive functions interacting constantly. However, their interaction is not yet well characterized during sound sequence encoding. We independently manipulated both selective attention and working memory in a delayed-matching-to-sample of two tone-series, played successively in one ear. During the first melody presentation (memory encoding), weakly or highly distracting melodies were played in the other ear. The difference to detect between the two melodies to compare could be easy or difficult, requiring low- or high-precision encoding, i.e., low or high memory load. 16 non-musician and 16 musician participants performed this new task. As expected, both groups of participants were less accurate in the difficult memory task and in difficult-to-ignore distractor conditions. Importantly, an interaction between memory task difficulty and distractor difficulty was found in both groups. Non-musicians presented less difference between easy and difficult-to-ignore distractors in the difficult than in the easy memory task. On the contrary, musicians, with better performance than non-musicians, showed a greater difference between easy and difficult-to-ignore distractors in the difficult than in the easy memory task. In a second experiment including trials without distractor, we could show that these effects are in line with the Cognitive Load Theory. Taken together, these results speak for shared cognitive resources between working memory and attention during sound sequence encoding.

Keywords

Attentional filtering; Working memory; Auditory; Non-verbal; Memory encoding; Selective attention

Introduction

Working memory and selective attention are two essential cognitive functions. Working memory (WM) is the cognitive ability to maintain and manipulate information during a limited period of time (Baddeley, 1992; Joseph et al., 2016). Information, while accessible, is transcribed in the brain as memory traces: this process is called encoding. Memory traces are refreshed during the retention period in which information is no longer available; when needed, memory traces are re-activated during retrieval (Baddeley, 1992). Attention, on the other side, has been defined in many ways for the past decades. We refer here to the ability to allocate resources to cognitive processes, these resources being limited. In particular, selective attention is crucial for selecting relevant information and filtering out distracting elements.

Interestingly, an attention component is present in several models of WM. In Baddeley's WM model (Baddeley, 2000; Baddeley & Hitch, 1974), WM is a multi-component system, including active storage components (phonological loop and visuo-spatial sketchpad) and a central executive system which is regarded as an attentional control system. In Cowan's WM model, no more than 3 to 5 separate units of information, or chunks, can be held active at the same time and it was proposed that this limit may be the capacity of the attentional focus, i.e., the scope of attention (Conway et al., 2001; Cowan, 1988, 2008). In the WM model from Barrouillet and colleagues, attentional resources are necessary to perform a concurrent task and update the memory traces during the delay period (Barrouillet et al., 2004, 2013). They predict that a task, not necessarily complex, but capturing attention for frequent and sufficiently long periods of time will have a detrimental effect on WM span.

To summarize, as reviewed in Adams et al. (2018), most models of WM acknowledge a role for attention in storage and/or processing of the information held in WM, but none of these models specifically deals with the influence of attention on encoding in WM.

Memory components can also be part of theoretical frameworks of attention. According to the Cognitive Load Theory (Lavie et al., 2004; Lavie, 2005; Yi et al., 2004), under low cognitive load, there are enough spare cognitive resources for selective attention to filter irrelevant elements; while under higher cognitive load, the limited cognitive resources are devoted to the difficult relevant task, and less available to the active suppression of irrelevant information. Importantly, in this framework, the cognitive load is mostly meant as a WM load, suggesting shared cognitive resources between selective attention (and more particularly distractor inhibition) and WM during the retention period. A complementary theory is the Perceptual Load Theory: distractor processing can be automatically reduced at early perceptual stages

when processing of task-relevant stimuli involves high perceptual load (*i.e.* a high amount of perceptual capacities are devoted to relevant information processing and no more perceptual capacity is available for irrelevant information processing), while under low perceptual load distractor processing could be reduced at later processing stages according to the available cognitive resources (Cartwright-Finch & Lavie, 2007; Forster & Lavie, 2007; Handy & Mangun, 2000; Huang-Pollock et al., 2002; Lavie, 1995; Lavie et al., 2014; Lavie & Cox, 1997; Lavie & Tsai, 1994). Importantly, these two theories result in opposite behavioral effects of increasing load on distractor interference, while increasing perceptual load is believed to reduce interference thanks to automatic suppression, increasing cognitive load would enhance interference because of reduced active suppression.

Attention and WM have been studied separately for a long time but more and more research projects in modern psychology and neuroscience try to decipher their impact on each other, to uncover their common resources and to characterize their cooperation (Awh & Jonides, 2001; Colflesh & Conway, 2007; Rutman et al., 2009). In the visual domain, several studies have investigated the impact of attention on each memory step (encoding, retention, retrieval). It appears that presenting irrelevant images or symbols during encoding leads to lower recall performance, underlining an influence of selective attention on WM performance. Regarding early sensory processing stages, distractor-related modulation of the P100 event-related potential and WM performance are correlated (Fougnie, 2008; Gazzaley, 2011; Rutman et al., 2009). During memory retention and retrieval, presentation of task-irrelevant probes can enhance performance in terms of reaction time, accuracy and span if they share features with the encoded information (Awh et al., 2000; Awh & Jonides, 2001; Dowling, 2012; Theeuwes et al., 2011), but otherwise tends to reduce performance in terms of reaction time and accuracy (Awh et al., 1998; Banbury et al., 2001; Jha, 2002), interrupting memory traces update (Postle et al., 2004; Soto et al., 2008). During the retrieval period, unexpected probes can reduce recall performance (Park et al., 1989), but attention orienting probes can improve recall of features or items (Nelson & Goodmon, 2003). In the auditory domain, most studies have been conducted using verbal stimuli, revealing that divided attention during encoding impedes recognition of words assigned with a high value in the experiment design (Elliott & Brewer, 2019), and that divided attention during retrieval causes performance drop (Lozito & Mulligan, 2006). Most studies focus on the impact of distraction during the retention period, showing evidence for a major impact of attention on selection, span, and update of encoded

information (for a review, see Banbury et al., 2001): more numerous distractors lead to poorer performance.

Concerning the effect of WM on attentional processes, studies with auditory stimuli have shown that the effect of distracting sounds on WM task performances are reduced under high memory load (Bayramova et al., 2020; Berti & Schröger, 2003; SanMiguel et al., 2010). However, the inhibitory component of attention in the auditory domain is reduced under high memory load (Bidet-Caulet, Mikyska, & Knight, 2010) and whatever the modality tested, performance in attentional tasks is poorer under high memory load (Awh & Jonides, 2001; Colflesh & Conway, 2007; Lavie, 2005; Melara et al., 2005; Pratt et al., 2011), except when relevant features are part of the memorized information (Johnson et al., 2007). Overall, these results suggest that there is an overlap, at least partial, between selective attention and WM processes.

The aim of the present study is to uncover the links between auditory selective attention and WM. In a classroom or conference situation, irrelevant distracting noises have to be ignored while we listen to and encode the relevant information delivered by the teacher or speaker. How do auditory selective attention and auditory WM interact during encoding? Few studies have jointly investigated the effect of selective attention and WM encoding on one another, particularly in the auditory modality which is however central in this daily situation. Visual stimuli often remain accessible, while auditory stimuli are transient and quickly become non accessible. Hence, memory processes and their interaction with selective attention possibly differ between the auditory and visual modalities. As more numerous studies were devoted to the interaction between memory and attention in the visual domain, it seems particularly interesting to study the interaction of this processes in the auditory domain. Moreover, focusing on non-verbal auditory stimuli allows us to evaluate attention and memory in the absence of language-dependent processes. Various results are in favor of WM network partly separated for music and language (Caclin & Tillmann, 2018). However, some mechanisms (subvocal rehearsal, time-based serial-order mechanisms) seem to be used with both types of stimuli. To our knowledge, there is no comparison of attentional selection mechanism for language and tones in the current literature, and the use of non-verbal auditory stimuli has not been operated yet to study attention and memory interaction during encoding.

In the present study, we propose a paradigm designed to manipulate **both** non-verbal auditory attention and WM during sound sequence **encoding**, allowing us to study their respective

impact on each other. To this aim, we designed a delayed-matching-to-sample task where participants have to compare two sequences of sounds (short isochronous melodies) played subsequently in the same ear, with a 2-second delay. The presentation of the first melody is coupled with the presentation of an interleaved distracting melody in the other ear. In this paradigm, participants are expected to filter out the distracting melody and to encode the relevant melody at the same time. However, they have to give an overt answer for the memory task only, an important distinction with respect to dual task paradigms (Dalton et al., 2009; Huang et al., 2013). The differences between the melodies to compare can be either easy or difficult to detect. The participants being fully aware in advance of the difficulty of the memory task (block design), they know they have to encode the first melody with low or high precision. Enhancement of the encoding precision has been shown to result in increased sustained evoked responses to the melody, reflecting a greater recruitment of resources for the encoded melody (Albouy et al., 2013), in line with an increase in memory load.

Additionally, we created a matched Perception task where participants have to compare the last two tones of a melody played in one ear, in the presence of a distracting melody in the other ear, with an easy or difficult level of discrimination. The Perception task allows us to be sure of the capacity of our participant to spot a small change in pitch while ignoring distracting melodies, and to evaluate the impact of attention alone, as the duration of the retention period between the sounds to compare and the memory load are then very reduced. It also might be relevant to have such a matched Perception task in future experiments, e.g., in fMRI (Albouy et al., 2019).

By investigating in three experiments how distracting non-relevant sounds presented during the encoding period are, we could specify the link between attention and memory processes during the encoding of non-verbal sounds. Given the nature of the task, performance was expected to depend highly on participants' musical expertise, hence in the main experiment, only non-musician participants are tested with the new MEMAT paradigm (MEMAT for MEMory and ATtention). In the second experiment, expertise effects on the cognitive processes of interest were evaluated through the testing of highly trained musician participants. Finally, the third experiment with non-musician listeners served to arbitrate between two alternative interpretations of the results.

Experiment 1: Memory and Attention manipulation in non-musicians

To limit the impact of any expertise with musical stimuli manipulation, we tested non-musician participants with a first version of the MEMAT protocol (MEMAT-1), where, as detailed below, the melodies to encode were always accompanied by an interleaved distracting melody.

Methods

Participants

Sixteen paid non-musician participants (all right-handed, 4 men and 12 women, aged 20-33 years) participated in the first experiment. Participants were considered non-musicians when they never practiced any instrument nor singing outside compulsory educative programs. This number of participants allows a full balance of all conditions and is in the same range as similar psychological investigations (Albouy et al., 2016; Baddeley, 1966; de Fockert, 2001; Joseph et al., 2015; Talamini et al., 2021).

All participants were free from neurological or psychiatric disorder and had normal hearing and normal or corrected-to-normal vision. All participants gave their written informed consent to participate. Experimental procedures were approved by the appropriate regional ethics committee.

Neuropsychological tests and questionnaires

Participants were asked to perform subtests of the WAIS (WM subtest: forward, backward, and ascending digit spans, arithmetic; Processing Speed subtest: codes, symbols). They also had to fill-in self-evaluation questionnaires about their attention (Adult Self-Report Scale, Schweitzer et al. 2001 - going from 0 to 30, high scores indicating attentional difficulties), and their anxiety and depression level (Hospital Anxiety and Depression Scale, Zigmond, Snaith, 1983). This allowed us to prevent from a major impact of anxiety or depression issues on cognitive processes, as the score of all participants was contained in the normal range. Demographic and neuropsychological data are summarized in Table 1.

Variable	Experiment 1 MEMAT-1 non-musicians		Experiment 2 MEMAT-1 musicians		Group comparison Experiment 1 vs 2		Experiment 3 MEMAT-2 non- musicians		Group comparison Experiment 1 vs 3	
	mean	SD	mean	SD	BF10	error %	mean	SD	BF10	error %
Sex	men: 4 women:12		men: 4 women:12		0.5	-	men: 5 women:11		0.9	-
Laterality	69.7	32.8	77.6	19.1	0.3	0.2 e-3	64.4	40.6	0.6	0.5 e-3
Years of music education	0.0	0.0	15.7	4.1	<i>5.4e+7*</i>	1.5e-11	0.0	0.0	-	-
Years of school education	15.7	1.2	14.9	1.3	0.6	0.6 e-3	16.4	1.1	1.1	0.1 e-1
Age (years)	23.8	3.7	23.4	2.8	0.3	0.2 e-3	23.6	2.4	0.3	0.2 e-3
Attention (ASRS)	4.6	2.6	5.5	5.0	0.3	0.2 e-3	5.3	3.2	0.4	0.1 e-3
Anxiety (HAD-1)	9.4	4.2	7.2	3.6	0.8	0.9 e-3	6.9	4.2	0.9	0.9 e-3
Depression (HAD-2)	3.4	2.0	3.0	2.0	0.3	0.2 e-3	2.5	2.1	0.4	9.6 e-4
WM WAIS Index	103.9	13.1	112.6	12.5	1.1	0.1 e-1	106.1	10.9	0.3	8.8 e-4
WM: Sub-test Span Forward	10.8	1.4	11.6	2.2	0.4	8.3 e-4	10.7	2.3	0.3	0.1 e-3
WM: Sub-test Span backwards	8.7	1.3	10.8	2.3	<i>4.7</i>	2.6 e-5	8.9	1.9	0.3	0.2 e-3
WM: Sub-test Span ascendant	10.2	1.5	10.3	2.8	0.3	0.2 e-3	11.3	2.5	0.9	0.9 e-3
WM: Sub-test Arithmetic	15.4	3.5	16.6	2.4	0.3	0.2 e-3	15.8	3.0	0.3	0.2 e-3
Speed WAIS Index	112.0	13.7	121.9	16.8	0.5	0.2 e-3	113.8	9.3	0.3	0.2 e-3
Speed: Sub- test Codes	82.1	11.7	93.3	17.9	1.4	0.8 e-3	85.8	5.0	0.6	0.4 e-3
Speed: Sub- test Symbols	103.9	13.1	93.3	18.0	0.3	0.2 e-3	85.8	8.9	0.3	0.2 e-3

*Table 1- Demographic and questionnaire information for all groups of participants. For each variable, mean and standard deviation (SD) for each group are given, as well as the Bayesian Factors (BF₁₀) for the comparison between groups (contingency table for sex, t-test otherwise). Positive to decisive evidence against the null hypothesis are highlighted in bold and italics. Laterality: Edinburgh index, %; ASRS: Adult ADHD Self-Report Scale, from 0 to 18; HAD: Hospital Anxiety and Depression scale, HAD-1 from 0 to 21, HAD-2 from 0 to 21; each sub-test of the WAIS from 1 to 19; WAIS Indexes are composite notes derived from the raw scores ranging from 46 to 154, where 100 is the average performance in the population. *: One sample t-test for comparison to zero of musicians' data.*

Material

96 four-note-long melodies were created using pseudo-random combinations of eight-harmonic synthetic tones from the C major scale, spanning two octaves between 110 Hz and 440 Hz. The maximal interval between any two notes of a melody is 7 semi-tones. Notes are 250-ms long the interval between notes (offset to onset) is 250 ms, with 10-ms-long fade-in and fade-out. Examples of melodies can be listened online [here](https://osf.io/27a54/?view_only=ef526f1cabdf4021bbc3c51e0e00c422) (https://osf.io/27a54/?view_only=ef526f1cabdf4021bbc3c51e0e00c422 – for optimal listening, we recommend that you use stereophonic headphones). In each melody, there are no consecutive identical notes. Every melody contains at least an ascending and a descending interval. For the perception tasks, a fifth note is added at the end of the melody, that can be either identical or different from the previous one.

Attention manipulation

S1 (the melody to encode) and DIS (the distracting melody to filter out) are interleaved, so that two sounds are never played simultaneously, in order to avoid masking effects between melodies. There is no gap between the offset of a note in one ear and the onset of the following note in the other ear. S1 is played in the indicated ear (see below), and DIS is played in the other ear, each note one after the other. The first sound to be played is the first note of S1, and the last note to be played is the last note of DIS.

The DIS melodies can be rather easy (easyDIS) or hard (hardDIS) to filter. An easy DIS melody is composed of notes in a frequency range separated by 6 or 7 semi-tones from the corresponding S1 melody frequency range (higher or lower in pitch). A hard DIS melody frequency range is the same than the corresponding S1 melody frequency range. DIS melodies are constructed with the same rules as for the S1 melodies, as described above. Presentation of easy- and hard-to-ignore distractors is randomized within a given block therefore participants are not aware in advance of their difficulty.

The attention manipulation used in MEMAT is based on two competing streams separately presented in each ear. The necessity to segregate the streams could be seen as a difficulty per se, present mostly for hard-to-ignore distractors, because of their pitch similarity with S1 tones. However, it has been shown that spatial information is very powerful for stream segregation, even with competing sequences of sounds of same frequencies: stream segregation can be performed starting from a spatial difference of 10° (Middlebrooks & Onsan, 2012; Middlebrooks & Waters, 2020). In MEMAT, the S1 and DIS melodies are

played separately in each ear, which make it easy to individualize the melodies, even in the highly distracting condition.

Memory task

During the memory task, for each trial (see Figure 1.A), the participant is informed of the ear of interest by an arrow presented during 800 ms (all visual contents are seven-centimeter-wide black elements displayed individually at the center of a white screen located at ~75cm from the participants' eyes). After the presentation of this arrow, the melody of interest (S1) and the distracting melody (DIS) are played in the headphones, in the ear of interest and in the other ear, respectively. After a 2000-ms pause, during which a cross is displayed on the screen, the melody (S2) to compare to S1 is presented in the ear of interest. There is no distracting melody during S2 presentation. The participant has then 2000 ms to answer to the question "Is S2 identical or different from S1?". When S2 differs from S1, only one note out of four differs, and it can be either the second, third, or fourth one, never the first one which would be too salient. The answer period starts at the end of the S2 melody, and an answer terminates the trial. When the participant does not answer within 2000 ms, a message indicating that no answer was recorded is displayed on the screen before the next trial.

In the memory task, all notes belong to the C-major scale. In the low memory task difficulty (low MEMdiff), when S2 differs from S1, one note is replaced by another which is 6 or 7 semi-tones apart (ascending or descending). In the high memory task difficulty (high MEMdiff), when S2 differs from S1, the changed note differs from the original one only by 1 or 2 semi-tones. The related enhancement of encoding precision is correlated with an amplitude increase of sustained evoked responses to the melody (Albouy et al., 2013). This reflects a greater recruitment of resources during the melody presentation, and therefore during the melody encoding, which is in line with an increase in memory load. The difficulty of the memory task (MEMdiff) is fixed within a block, participants are notified of this difficulty at the beginning of each new block.

Perception task

In the Perception task (see Figure 1.B), the participant is informed of the ear of interest by an 800-ms-long arrow displayed on the screen. After the arrow presentation, S1 and DIS melodies, which are composed of five notes each, are played in the ear of interest and in the other ear, respectively. The participant has then to answer to the question "Are the last two tones of the melody of interest identical or different?". The answer period starts at the end of

S1, and any answer terminates the trial. The delay during which participants have to memorize the two last tones is very reduced (250ms) compared to the memory task (2s).

When the participant does not answer, a message indicating that no answer was recorded is displayed on the screen before the next trial.

In the low perception task difficulty (low PERdiff), when the two last S1 notes are different, they are 3 or 4 semi-tones apart (always in the C-major scale), ascending or descending. In the high perception task difficulty (high PERdiff), when the two last S1 notes are different, they differ by a quarter of a tone (fifty-cent deviation), ascending or descending.

The difficulty of the perception task (PERdiff) is fixed within a block, participants are notified of this difficulty at the beginning of each new block. The main difficulty in this task is not to memorize correctly the information, but to perceive the slight difference with the preceding tone, especially as the delay (250 ms) between the two tones to compare is very reduced in comparison with the memory task, and only one item has to be kept in memory.

Procedure

Participants are seated in a comfortable armchair in a sound-attenuated room, at ~75cm distance from the screen (1280x1024 pixels, 17"). All stimuli are delivered using Presentation software (Neurobehavioral Systems, Albany, CA, USA). Sounds are delivered through a set of Sennheiser HD 280 pro headphones. First, participants have to fill in questionnaires and undergo an audiogram to confirm their self-reported absence of auditory deficit. Second, they perform short training blocks (8 trials) for all four block types (two tasks x two difficulties: low-difficulty memory task, high-difficulty memory task, low-difficulty perception task, high-difficulty perception task). The difficulty of the distractors (DISdiff) is randomized within blocks. Training melodies (S1, DIS, and S2) are specific to the training sessions. Third, they perform the four experimental blocks (48 trials each), in the same order as the training blocks.

Trials last a maximum of 5300ms during the perception blocks, and a maximum of 8800ms during the memory blocks, leading to four-minute-long perception blocks and six-minute-long memory blocks.

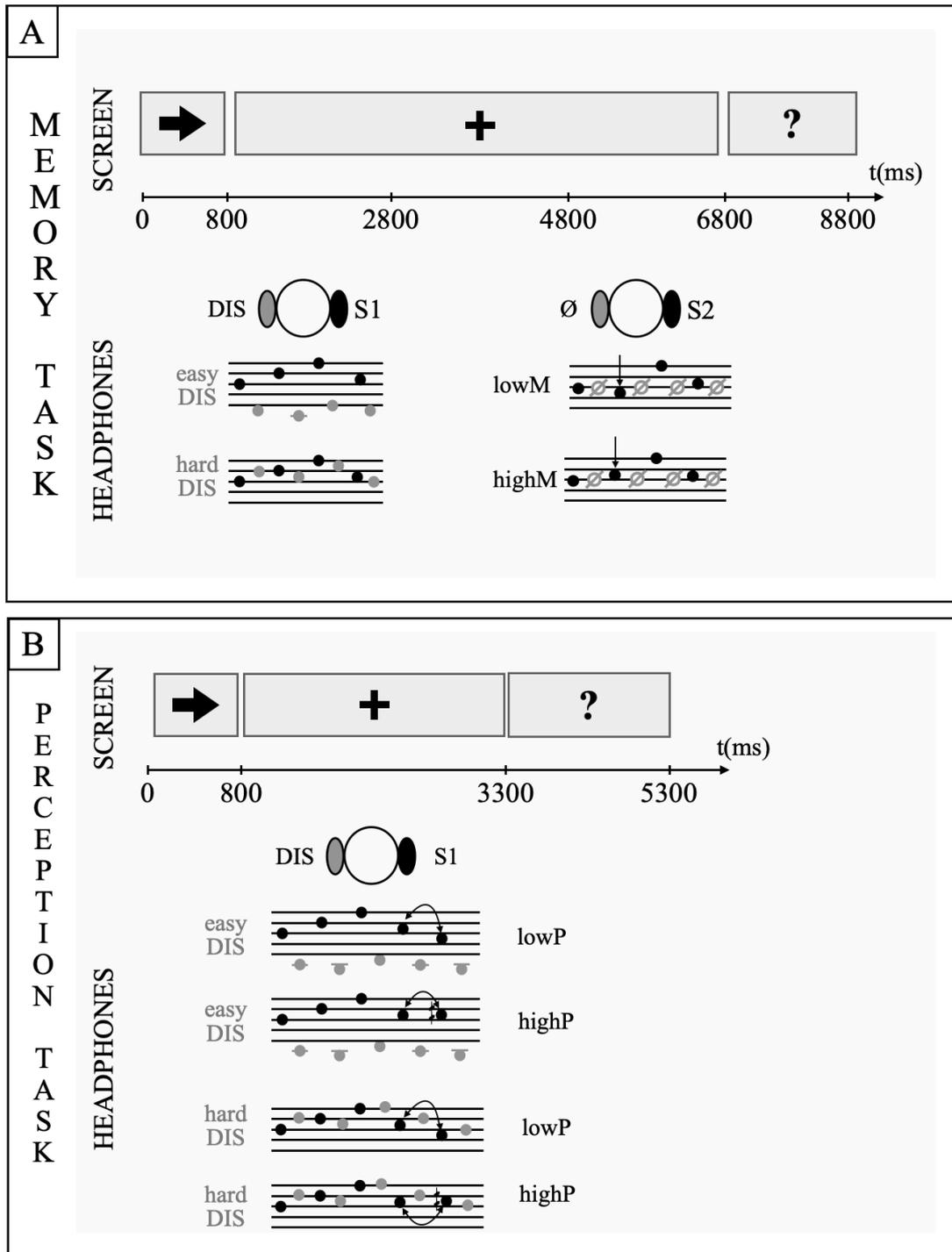


Figure 1 - Trial design in the Memory (A) and Perception (B) Tasks. In both tasks, the ear of interest is indicated at the beginning of each trial by an arrow. In the Memory task (A), participants have to encode the melody presented in the ear of interest (S1) in WM, while filtering out an interleaved distracting melody presented in the other ear (DIS). After a silent retention delay, a second melody (S2) is presented in the ear of interest, participants have to compare S1 and S2 (in black, the changing tone is indicated by an arrow). In trials where S2 differs from S1, changed sounds are 6 or 7 semi-tones different from the original one in the low difficulty memory task vs. 1 or 2 semitones in the high difficulty memory task. In the Perception task (B), participants have to compare the last two tones of the S1 melody, in black and indicated with an arrow (and ignore the DIS melody, in grey). In different trials, the last two notes of S1 differ by 3 or 4 semi-tones in the low difficulty perception task, vs. a quarter tone in the high difficulty perception task (the symbol \sharp represents here an ascending quarter tone).

Balancing – within blocks

Participants perform 4 blocks (48 trials each), in which the task (Memory, Perception) and its difficulty (low, high) are kept constant. They are informed of the identity of the task and its difficulty level. All the combinations of ear of interest (Left or Right), distractor difficulty (easy DIS or hard DIS), associated answer (same or different) are equiprobable within block (6 trials/block each). For each of these combinations with an expected answer “different”, the direction of the change is as likely to be ascendant or descendant in frequencies (3 trials/block each). In the Perception task, the last two sounds of the DIS melody can be identical or different independently of the difference between the two last sounds of the S1 melody (equiprobable combinations within blocks).

This within-block balancing thus allows us to control for side, expected answer, change direction, and (for the Perception task only) DIS last tones effects.

Balancing – between blocks

The same S1 melodies are used in all blocks. However, for a given S1 melody, the expected answer, the direction of the change in S2 (Memory task) or S1 (Perception task) on different trials, the level of DIS difficulty, and the side of presentation are balanced across blocks. The goal of using the same melodies in each block is to limit peculiar (and difficult to anticipate) effects linked to a given melody. Moreover, we designed this task with the aim of carrying out electrophysiological recordings later. Using the same melodies across blocks allows us to equalize the acoustic input across conditions.

Block orders are balanced between subjects (Latin square). For half of the participants, melodies S1 and DIS are inverted and become respectively DIS and S1.

Association between one S1 melody and another DIS melody changes across participants, enabling us to limit the impact in the results from any unfortunate easy or difficult match.

Data Analysis

All analysis were conducted using Bayesian statistics, which allow to test the similarity between measures and to estimate a degree of logical support or belief regarding specific results, as implemented in the JASP software (Marsman & Wagenmakers, 2017; Wagenmakers et al., 2018).

Trial rejection

Trials in which participants gave no answer, several answers, or did answer at an inappropriate moment (*i.e.*, outside of the indicated period) are excluded from analysis. The average number of valid trials is 185.4 (\pm SD 5.7) out of 192 trials per participant. There is weak evidence for no difference of the number of trials rejected between the different combinations of the main variables (memory or perception task, low or high task difficulty, easy or hard distracting melody; Bayesian repeated-measure ANOVA: BF_{10} for all tested models <0.77).

Measurements

Performance was assessed using signal detection theory indexes. d' is the difference between normalized “Hits” and normalized “False alarms”. Hits are the proportion of correct “different” answer over all “different” trials, and False alarms are the proportion of incorrect “different” answer over all “same” trials.

Criterion (c) indicates the response bias. Positive values indicate the tendency of answering “same” and negative values reflect the tendency of answering “different”.

Median Reaction Times (RTs) are computed out of correctly answered trials and correspond to the time between the end of the sound (*i.e.*, S1+DIS in the perception blocks, and S2 in the memory blocks irrespective of the change position in S2) and the button press.

Main statistical analyses

Firstly, to have a global overview of the data, d' and c were submitted to a Bayesian repeated-measure ANOVA with TASKdiff (difficulty of the task, two levels: low, high), DISdiff (difficulty of the DIStractor, two levels: easy DIS, hard DIS), and TASK (two levels: Memory, Perception) as within-participant factors. Additionally, criterion for each main factor combination (TASKdiff x DISdiff x TASK) were submitted to a Bayesian one-sample t-test comparison to zero.

Yet, the Memory and Perception tasks are quite different, the main analysis is thus conducted separately for each task. d' , RTs and c were submitted to a Bayesian repeated-measure ANOVA with TASKdiff (difficulty of the task, two levels: low, high), DISdiff (difficulty of the DIStractor, two levels: easy DIS, hard DIS), separately for Memory and Perception tasks (the factor TASKdiff is then called MEMdiff and PERdiff according to the task analyzed).

The different trial temporal structures in the two tasks (see Fig. 1) precluded a joint analysis of RTs.

Post-hoc comparisons for main effects or interactions were conducted using Bayesian t-tests. We reported Bayes Factor (BF_{10}) as a relative measure of evidence of a given model (compared to the null model). To interpret the strength of evidence against the null model, we considered a BF between 1 and 3 as weak evidence, a BF between 3 and 10 as positive evidence, a BF between 10 and 100 as strong evidence and a BF higher than 100 as a decisive evidence (Lee & Wagenmakers, 2014). Similarly, to interpret the strength of evidence in favor of the null model, we considered a BF between 0.33 and 1 as weak evidence, a BF between 0.01 and 0.33 as positive evidence, a BF between 0.001 and 0.01 as strong evidence and a BF lower than 0.001 as a decisive evidence.

Additionally, we report for each factor and interaction the $BF_{inclusion}$ that compares models that contain the effect to equivalent models stripped of the effect and was considered as a relative measure of evidence supporting the inclusion of a factor.

Results – MEMAT 1, non-musician listeners

For d' (Figure 2A-1, Sup.Tables S1a and S1b), the best model explaining all Memory and Perception results of MEMAT-1 in non-musicians is the one with factors TASK, task difficulty (TASKdiff), distractor difficulty (DISdiff), and the interaction between TASKdiff and DISdiff ($BF_{10}=1.3e+11$). There is decisive evidence for TASKdiff ($BF_{inclusion}=3.7e+6$) and for DISdiff ($BF_{inclusion}=6.9e+4$) effects, strong evidence for the TASK effect ($BF_{inclusion}=10.3$) and positive evidence for the TASKdiff x DISdiff interaction ($BF_{inclusion}=4.4$). There is positive evidence for no effect of the TASK x DISdiff interaction ($BF_{inclusion}=0.2$).

Overall, d' s were higher in the Memory task compared to the Perception task. In both tasks, d' are higher for easy-to-ignore distractors (easy DIS) compared to hard-to-ignore distracting melodies (hard DIS), and higher under low task difficulty compared to high task difficulty. The results obtained in Experiment 1 confirms the design of the difficulty levels of the distractors and the difficulty levels of the two tasks. Difference between hard DIS and easy DIS is less important when task difficulty is high compared to low (see below for post-hoc tests in the separate analysis of d' in Memory and Perception tasks).

For the Memory task results analyzed alone, similar results are found (Memory: best model comprises the memory task difficulty MEMdiff, DISdiff and their interaction, $BF_{10}=7.7e+7$; $BF_{inclusion}[MEMdiff]= 479107.6$, $BF_{inclusion}[DISdiff]= 1542.3$, $BF_{inclusion}[MEMdiff \times DISdiff]= 3.1$; see Sup.Tables S2a and S2b). Post-hoc statistics indicate decisive evidence for a

difference between DISdiff levels under low memory task difficulty ($BF_{10}=665.6$), but weak evidence for any difference between DISdiff levels under high memory task difficulty ($BF_{10}=1.3$). This result is in favour of an interaction between working memory and attentional processes.

In the Perception task alone, the interaction is not included in the best model (Perception: best model includes the perception task difficulty PERdiff and DISdiff, $BF_{10}=395.0$; $BF_{inclusion}[PERdiff]=24.4$, $BF_{inclusion}[DISdiff]=32.0$, $BF_{inclusion}[PERdiff \times DISdiff]=1.0$; see Sup.Tables S3a and S3b). The data pattern is not fully conclusive concerning the differential effect of distraction according to the difficulty of the perception task, suggesting no major influence of the Perception task difficulty on attention processes.

For the criterion, in agreement with previous studies using delayed-matching-to-sample tests, there is weak evidence for positive c values or an absence of difference from zero (see SupTable S4), underlining that participants tended to miss differences between melodies. The best model explaining results from MEMAT-1 in non-musicians includes TASK, TASKdiff, and DISdiff ($BF_{10}=8957.2$). There is positive evidence for TASK effect ($BF_{inclusion}=5.9$) and decisive evidence for TASKdiff effect ($BF_{inclusion}=1297.1$): criterion is higher for the Perception than for the Memory task and is higher under high than under low task difficulty (see Sup.Tables S5a et S5b). There is only weak evidence for DISdiff effect ($BF_{inclusion}=2.3$).

In the Memory task, the best model explaining the result includes MEMdiff and DISdiff ($BF_{10}=2550.7$). There is decisive evidence for MEMdiff effect ($BF_{inclusion}=2755.5$): criterion is higher under highM than under lowM (see Sup.Tables S7a and S7b). There is only weak evidence for DISdiff effect ($BF_{inclusion}=1.1$). In the Perception task, the best model explaining the results includes PERdiff ($BF_{10}=1.5$). Therefore, there is weak evidence towards an effect of PERdiff (see Sup.Tables S6a and S6b).

For the RTs (Figure 2A-2.), the best model explaining results from MEMAT-1 in non-musicians is the one with the difficulty of the memory task (MEMdiff) and DISdiff for the Memory task alone ($BF_{10}=661.0$; see Sup.Table S8a) and the one with DISdiff for the Perception task alone ($BF_{10}=41.0$; see Sup.Table S9a). There is strong to decisive evidence for DISdiff effect in both tasks (Memory: $BF_{inclusion}=283.9$; Perception: $BF_{inclusion}=41.6$), and positive evidence for MEMdiff in the Memory task ($BF_{inclusion}=4.0$) (see Sup.Tables S8b and S9b).

In both tasks, RTs are longer for hard DIS compared to easy DIS. In the memory task only, RTs are longer for high compared to low MEMdiff.

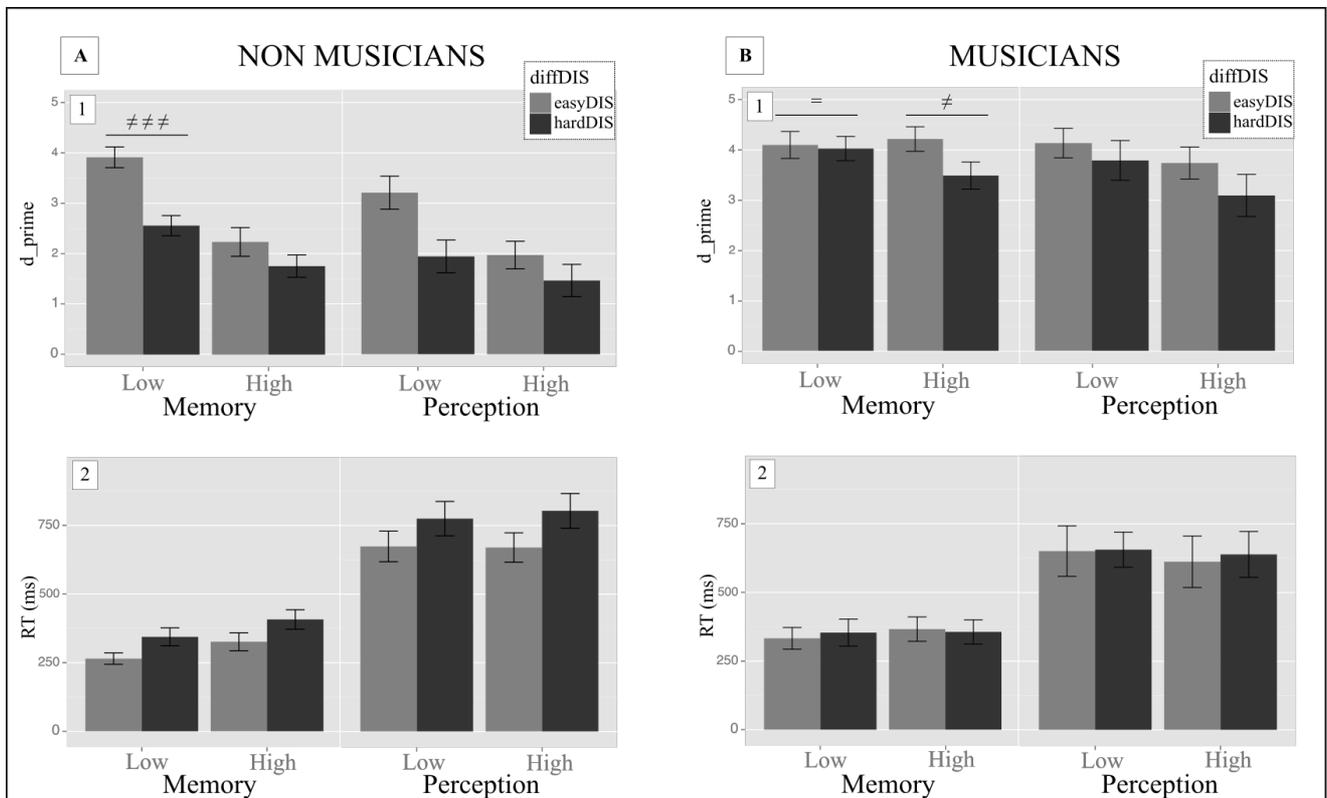


Figure 2 - Behavioral results of MEMAT-1, non-musician (A) and musician (B) participants. Effects of the distraction difficulty and task difficulty on d' (1, top panels) and RT (2, bottom panels). Results of post-hoc t -tests of the TASKdiff by DISdiff interaction on d' in the Memory task: "###" corresponds to $BF > 100$ (decisive evidence), "#" corresponds to $10 > BF > 3$ (positive evidence), "=" corresponds to $0.33 > BF > 0.1$ (positive evidence in favour of the null model). Bars represent standard error of the mean.

Discussion

Overall, the results of Experiment 1 confirm the expected influence of the distractor and task difficulty levels on performance. The hypothesis that difficult distracting melodies were more distracting than easy distracting melodies was supported in terms of both d' and RTs (see Fig.2), in line with previous results from Deutsch & Feroe (1975). High task difficulties result in lower d' in both Perception and Memory tasks (and longer RTs in the Memory task), going along with a greater tendency to answer “same” (higher c), *i.e.*, to miss differences. There is evidence for an absence of interaction between the distractor difficulty and the task on d' , meaning that the distractor impact is rather similar in both tasks. Criteria are higher for Perception than for Memory task, showing a greater tendency to answer “same” in the Perception Task. This might be due to a greater difficulty to spot a quarter of a tone and third intervals (Perception task) than second and fourth intervals (Memory task), explaining also the slight decrease of performance in the Perception task. Nonetheless, performance in the Perception task confirms that participants can reliably perceive quarter of a tone and third intervals, which suggests that the WM performance will not be limited by perceptual difficulties.

In terms of d' , we observed evidence for an interaction between distractor difficulty and task difficulty in the memory task, which underlines greater distractor difficulty cost (hard minus easy DIS) for low compared to high memory task difficulty. This interaction effect points to a differential impact of the memory task difficulty on distractor processing –or conversely to an impact of distractor inhibition difficulty on memory processes– and thus to shared resources between attention and WM processes during WM encoding. Interestingly, the depth of distractor processing might depend on inhibitory processes efficiency and could impact the memory trace precision. The more the distractors are processed and interfere during WM encoding and/or maintenance, the more degraded would be the memory trace and the worse the performance. This effect should be more pronounced for distractors that are similar to the target to encode (hardDIS condition).

To further investigate the shared resources between distractor filtering and WM processing and to identify possible separate resources, we decided to study a sub-group of the population with a different profile in terms of WM, and therefore to assess the effect of musical expertise on these processes (Experiment 2). It has indeed been established that musicians have

enhanced WM performance, especially for musical sounds (for a recent meta-analysis, see Talamini et al., 2017). Testing musicians with our MEMAT paradigm allows to see whether music expertise also impacts attentional performance.

The interaction between distractor difficulty and task difficulty observed in this first experiment can be explained in two different ways in light of the **cognitive** and **perceptual** load theories (Lavie et al., 2004; Lavie, 2005).

According to the **Cognitive** Load Theory (Lavie et al., 2004; Lavie, 2005; Yi et al., 2004), under low cognitive load (here the low memory task difficulty), there are enough spare cognitive resources to filter out easy-to-ignore distractors but not to suppress hard-to-ignore distractors; while under higher cognitive load, the limited cognitive resources are devoted to the difficult memory task performance and less available to inhibit distractors, irrespective of their difficulty to be ignored.

According to the **Perceptual** Load Theory (Cartwright-Finch & Lavie, 2007; Forster & Lavie, 2007; Handy & Mangun, 2000; Huang-Pollock et al., 2002; Lavie, 1995; Lavie et al., 2014; Lavie & Cox, 1997; Lavie & Tsal, 1994), under low perceptual load (here the low memory task difficulty), there is enough perceptual resources to process both relevant and irrelevant information, hard-to-ignore distractors leading to greater interference; whereas under higher perceptual load (here the high memory task difficulty), the limited perceptual resources are devoted to process relevant information and not available to process distractors, irrespective of their difficulty to be ignored.

Thus, according to both theories, increasing the memory task difficulty would result in similar performance for easy and hard-to-ignore distractors, because (1) neither of them would be inhibited according to the Cognitive Load Theory, or (2) none of them would actually be processed in-depth according to the Perceptual Load Theory.

Therefore, both of these theories can explain this lower distractor difficulty cost for high than low memory task difficulty. However, these two theories lead to different predictions on what would be the performance in the absence of distracting melodies. Indeed, according to the **Cognitive** Load Theory, in the high memory task difficulty, there would be few cognitive resources available to inhibit even easy-to-filter-out distractors, resulting in strong interference. Performance should be better in the absence than in the presence of easy-to-filter-out distractors. On the contrary, according to the **Perceptual** Load Theory, in the high memory task difficulty, all perceptual resources would be allocated to the processing of the

relevant sounds, *i.e.*, the S1 melody, and there would be few perceptual resources available to process distractors, resulting in low interference and in similar performance in the presence or absence of distracting information.

To tip the scale towards one of the two models, we performed a third experiment using a new experimental condition with the absence of distracting melodies (MEMAT-2). As the memory task difficulty is more likely to act as a cognitive load, we predict results in agreement with the cognitive load theory. However, as this MEMAT task also relies on the encoding of a perceptual attribute, results in line with the perceptual load theory cannot be dismissed.

To summarize, we ran two additional experiments, one to test the impact of musical expertise on WM and attention in MEMAT (Experiment 2: Working Memory and Attention manipulation, impact of musical expertise) and the other to decide whether MEMAT results are in line with the Perceptual or the Cognitive Load theory using a new experimental condition with no distracting melody (Experiment 3: MEMAT-2, arbitrate between cognitive or perceptual load).

Experiment 2: Working Memory and Attention manipulation, impact of musical expertise

Musicians have greater WM performance than non-musicians, especially in the auditory non-verbal domain (Talamini et al., 2017, 2021). This could be due to an increased ability to regroup isolated tone information into chunks, or to reduce the amount of information to keep in memory by memorizing the contour of a melody instead of the tone identity, or to other factors (Talamini et al., 2017, 2021). Therefore, we expect musicians to be better at the memory task, in terms of d' and RT, and to be less impacted by the difficulty of the task. We also expect them to be better at the perception task, as their perception of musical note differences has been reinforced by training. Does music expertise also impact attention performance? If yes, we would expect musicians to have lower distractor difficulty cost than non-musician. Conversely, an absence of an effect of musical expertise on attention performance would point towards some separate resources between WM and attention.

Methods

Participants

Sixteen paid musician participants (all right-handed, 4 men and 12 women, aged 18-34 years) took part in the second experiment. They were professional musicians or conservatory students. They were matched to the non-musician participants included in Experiment 1 in terms of school education, age, laterality, and sex (see Table 1).

All participants were free from neurological or psychiatric disorder and had normal hearing and normal or corrected-to-normal vision. All subjects gave their written informed consent to participate. Experimental procedures were approved by the appropriate regional ethics committee.

Psychological tests and questionnaires

Participants were asked to perform the same subtests of the WAIS and questionnaires as in Experiment 1 (forward, backward, and ascending digit span, arithmetic, codes, and symbols; ASRS, HAD).

Experiment

The experiment was MEMAT-1, the exact same one as described in Experiment 1.

Statistical Analysis

Bayesian t-tests were run in order to compare the two groups (musicians from Experiment 2 and non-musicians from Experiment 1) for all demographic information and questionnaire results, except for musical education. All non-musician participants had zero year of practice of music, leading to variance equal to zero, so we tested musicians' musical expertise in comparison to zero with a one-sample Bayesian t-test.

In the musician group, we first performed the same Bayesian analysis of d' and c with both tasks, as described in non-musicians in Experiment 1, and the same post-hoc analysis. Then, we present the ANOVAs computed on each task separately for an easier step-by-step analysis and interpretation.

For each task separately, we also compared results (d' , RT) from Experiments 1 and 2, *i.e.*, results of non-musicians and musicians under MEMAT-1 experiment, with a Bayesian repeated-measure ANOVA with TASKdiff (difficulty of the task, two levels: low, high), DISdiff (difficulty of the DIStractor, two levels: easy DIS, hard DIS) as within-participant factors, and GROUP (two levels: musicians, non-musicians) as a between-participant factor.

For each task separately, DIS difficulty cost (easy minus hard DIS) and Memory/Perception cost (low minus high task difficulty) were computed in terms of d' . To assess the effect of musical expertise on attentional filtering and task difficulty, four planned Bayesian t-tests were computed to compare groups for each cost (DIS difficulty cost, Memory/Perception cost) of each task (Memory, Perception).

Results – MEMAT 1, musician participants

Group comparisons: Demographics and neuropsychological data

Bayesian t-tests confirm that the two groups were matched in school education, age, laterality and sex ($0.3 < BF_{10} < 0.6$; see Table 1). Also, as expected, there is decisive evidence ($BF_{10} = 5.4e+7$) for a musical education level different from zero in the musician participants.

Bayesian t-tests show weak evidence for no difference in Attention, Anxiety, and Depression scores from ASRS and HAD questionnaires ($BF_{10} \leq 0.8$)

There is positive evidence for higher scores in musicians (mean 10.8 +/- SD 2.3) compared to non-musicians (mean 8.7 +/- SD 1.3) in the backwards digit span test ($BF_{10} = 4.7$), confirming better WM performance in musicians. There is also weak evidence for better performance in musicians (mean 93.3 +/- SD 17.9) compared to non-musicians (mean 82.1 +/- SD 11.7) in

the Code test ($BF_{10} = 1.4$). In the other subtests, there was weak to positive evidence for no difference between musicians and non-musicians ($0.3 < BF_{10} \leq 0.5$).

Musicians: Main results

For d' (Figure 2B-1., Sup.Tables S10a and S10b), the best model explaining all Memory and Perception results of MEMAT-1 in musicians is the one with factors TASKdiff and DISdiff ($BF_{10} = 54.3$). There is positive evidence for TASKdiff ($BF_{inclusion} = 4.7$) and strong evidence for DISdiff ($BF_{inclusion} = 15.8$) effects. Performance is better for easy-to-ignore distractors and for low task difficulties.

For the Memory task alone (see Sup.Tables S11a and S11b), the best model is the same as in non-musicians (Memory: best model comprises MEMdiff, DISdiff, and their interaction: $BF_{10} = 3.3$), even though it is close to the model with only DISdiff ($BF_{10} = 3.0$). There is weak evidence for the interaction effect ($BF_{inclusion} = 2.0$), but in a different way than for non-musician participants: for musicians, there is positive evidence for a difference between DISdiff levels under higher memory task difficulty ($BF_{10} = 9.1$), and for no difference between DISdiff levels under low memory task difficulty ($BF_{10} = 0.3$). There is positive evidence for the effect of DISdiff ($BF_{inclusion} = 3.1$), performance being better for easy-to-ignore distractors. There is weak evidence for no effect of MEMdiff ($BF_{inclusion} = 0.5$).

In the Perception task alone, as in non-musicians, the interaction is not included in the best model (Perception: best model includes PERdiff and DISdiff, $BF_{10}=9.9$; $BF_{inclusion}[PERdiff]=4.3$, $BF_{inclusion}[DISdiff]=2.8$, $BF_{inclusion}[PERdiff \times DISdiff]=0.3$; see Sup.Tables S12a and S12b).

For the criterion, there is no evidence for a difference from 0 for all values (see SupTableS4). The best model explaining results from MEMAT-1 in musicians includes TASKdiff only ($BF_{10}=9.8$). There is strong evidence for TASKdiff effect ($BF_{inclusion}=10.4$); criterion is higher under high memory or perception task difficulty than under low task difficulty. There is positive evidence for no effect of the interaction between TASK and TASKdiff ($BF_{inclusion}=0.3$) and of the interaction between TASK and DISdiff ($BF_{inclusion}=0.3$) (see Sup.Tables S13a et S13b).

For the RTs (Figure 2B-2.) the best model explaining the data is the null model, for both Memory and Perception tasks (see Sup.Tables 14a and 15a). In both tasks (see Sup.Tables S14b and S15b), there is weak to positive evidence for no effect of TASKdiff (Memory: $BF_{inclusion} = 0.4$; Perception: $BF_{inclusion} = 0.3$), and of DISdiff (Memory: $BF_{inclusion} = 0.3$; Perception: $BF_{inclusion} = 0.3$).

Group comparisons (Non-musicians from Experiment 1 and Musicians from Experiment 2)

For d' , in the Memory task alone (see Sup.Tables S16a and S16b), the best model explaining data from MEMAT-1 in non-musicians and musicians is composed of the following factors: group, MEMdiff, group \times MEMdiff interaction, DISdiff, group \times DISdiff interaction, MEMdiff \times DISdiff interaction, group \times MEMdiff \times DISdiff interaction ($BF_{10} = 7.2e+12$). There is decisive evidence for an effect of the group ($BF_{inclusion} = 455.6$), MEMdiff ($BF_{inclusion} = 25407.8$), DISdiff ($BF_{inclusion} = 11595.3$), and the interaction between group and MEMdiff ($BF_{inclusion} = 266.0$), positive evidence for an effect of the interaction between group, MEMdiff and DISdiff ($BF_{inclusion} = 17.5$), and weak evidence for no effect of the interaction between group and DISdiff ($BF_{inclusion} = 0.3$). Regarding the three-way interaction, as reported above, there is decisive evidence for an effect of distractor difficulty under low memory task difficulty in non-musicians ($BF_{10} = 665.6$), with no effect of distractor difficulty under high memory task difficulty ($BF_{10} = 1.3$); while there is positive evidence for this effect of distractor difficulty but under high memory task difficulty in musicians ($BF_{10} = 9.1$) and not under low memory task difficulty ($BF_{10} = 0.3$, see Fig. 2, top panels). To summarize, musicians have better performance than non-musicians, and the pattern of performance according to conditions is different between groups.

Musicians and non-musicians do not progress in the same way across blocks: non-musician participants have a greater progress rate than musicians, so if anything, between-group differences diminish across blocks (see Sup.Figure 1, Sup.Table 17a and S17b). Therefore, better performance in musicians cannot be explained by a quickly rising familiarity with the melodies as the experiment goes on.

For the Perception task alone (see Sup.Tables S18a and S18b), the best model explaining the data from MEMAT-1 in non-musicians and musicians is composed of the factors group, PERdiff and DISdiff ($BF_{10} = 3.6e+6$). There is strong to decisive evidence for effects of these

three factors (group: $BF_{inclusion}=73.9$, PERdiff: $BF_{inclusion}=419.1$, DISdiff: $BF_{inclusion}=351.4$), musicians having higher d' than non-musicians.

For RTs in the Memory task alone (see Sup.Table S19a), the best model explaining data from MEMAT-1 in non-musicians and musicians is composed of the following factors: MEMdiff, DISdiff, group, MEMdiff x group interaction, and DISdiff x group interaction ($BF_{10}=1693.1$). However, the second-best model is very close in terms of BF_{10} ($BF_{10}=1539.0$); it is composed of MEMdiff, DISdiff, group, and DISdiff x group interaction. There is strong evidence for an effect of MEMdiff ($BF_{inclusion}=19.6$), DISdiff ($BF_{inclusion}=25.4$) and group x DISdiff interaction ($BF_{inclusion}=13.6$), and weak evidence for an effect of MEMdiff x group interaction ($BF_{inclusion}=1.1$) (see Sup.Tables S19b). Non-musicians are slower for hardDIS compared to easyDIS ($BF_{10}=10.9$), whereas it is not the case for musicians ($BF_{10}=0.26$).

In the Perception task, the best model to explain the data is the model composed of the factor DISdiff, group and DISdiff x group interaction ($BF_{10}=73.5$, see Sup.Tables S20a). There is strong evidence for an effect of DISdiff ($BF_{inclusion}=22.8$), positive evidence for an effect of the DISdiff x group interaction ($BF_{inclusion}=4.6$), and weak evidence for no effect of the group ($BF_{inclusion}=0.7$) (see Sup.Tables S20b). Non-musicians are slower for hardDIS compared to easyDIS ($BF_{10}=41.7$), whereas it is not the case for musicians ($BF_{10}=0.3$).

Overall, musicians are more accurate in their answers, but not especially faster to respond than non-musicians, and the pattern of performance according to task difficulty and distractor difficulty differs in the two groups in the memory task. This group \times MEMdiff \times DISdiff interaction is further explored in the analysis of the distractor difficulty and memory task difficulty costs on d' reported in the following.

In the Memory task (see Figure 3-A), there is weak evidence for a difference of distractor difficulty cost between groups ($BF_{10}=1.8$) and strong evidence for a difference of memory cost between groups ($BF_{10}=75.5$).

Overall, musicians have smaller distractor difficulty and memory costs than non-musicians, but what they really seem to stand out for is a reduced memory cost. Whereas in non-musicians (Experiment 1) memory cost was larger than distractor difficulty cost ($BF_{10}=97.2$), there is no evidence for a difference between memory cost and distractor difficulty cost in musicians ($BF_{10}=0.4$) (Experiment 2).

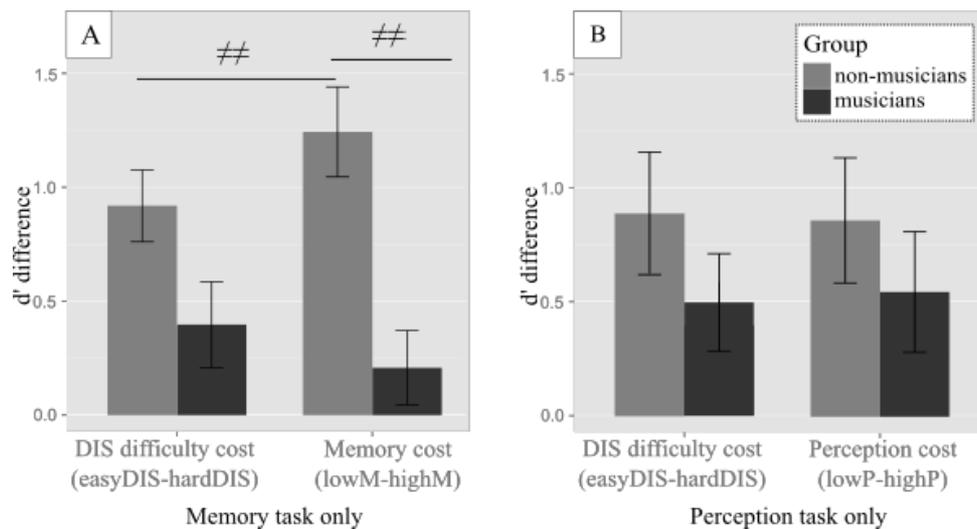


Figure 3 - Group comparison for distractor difficulty and memory (A) / perception (B) load costs on d' . Distractor difficulty cost is the difference between condition easy- and hard-to-ignore distractors under Memory (A) or Perception (B) tasks. Memory load cost is the difference between low and high memory task difficulty, Perception cost is the difference between low and high perception task difficulty. Results of planned t-tests between groups for each type of cost and between conditions for each group, in each task: ## refers to $10 < BF_{10} < 100$ (strong evidence against the null model). Bars represent standard error of the mean.

In the Perception task, concerning distractor difficulty and perception costs on d' (see Figure 3-B), there is weak evidence for no difference between groups for both costs (DIS difficulty cost: $BF_{10} = 0.6$; Perception cost: $BF_{10} = 0.4$).

Discussion

Musicians have overall better performance at the MEMAT task than non-musicians, with fewer errors and comparable to shorter reaction times, in all conditions of task difficulty or distractor difficulty. Comparing tones and melodies is an everyday training for musicians, which can explain that musician participants are overall more accurate than non-musicians in both Perception and Memory tasks. What is interesting here is that they do not all reach the maximum accuracy, showing that MEMAT is difficult enough to study WM and attention even in a population with expertise. However, they seem to reach minimum reaction times, which makes it hard to draw any conclusion from this floor effect. Therefore, we focus the interpretation on d' results.

There is no difference of distractor difficulty d' cost in the Perception task between non-musicians and musicians, pointing towards an absence of difference between musicians and non-musicians in terms of attention filtering. On the contrary, increasing memory task difficulty has a much weaker impact in musicians than in non-musicians, in agreement with studies showing better short-term memory performance for tone sequences in musicians

(Talamini et al., 2017). Differential impact of music expertise on WM and distractor difficulty costs is in favor of a dissociation, at least partial, between WM and attentional processes.

The extent of musicians' WM advantage over the non-musician participants can also be addressed from the results of the WAIS WM subtests, with only one (out of three measures) showing an advantage in musicians (backward digit span). This points to some degree of dissociation between WM for verbal (numerical) material in the WAIS and WM for musical material in MEMAT (Albouy et al., 2019; Talamini et al., 2021). Overall this pattern of results is compatible with the results of the meta-analysis of WM abilities in musically-trained participants of Talamini et al. (2017), which revealed a larger effect size for the improvement in tonal memory than for a possible improvement in verbal memory. Importantly, there was no difference in terms of WAIS speed index between musicians and non-musicians, speaking against a general improvement in information processing in musicians.

The enhanced tonal memory abilities in musicians help us to understand interactions between attention and WM. In musicians, the interaction between memory task difficulty and distractor difficulty on d' does not follow the same pattern as for non-musicians. In the low-difficulty memory task, it seems that for musicians the difficulty of the overall task is very low, and whether the distractors are easy or hard to ignore has no impact on performance. As the memory task difficulty becomes higher (high-M), hard-to-ignore distractors induce a decrease in performance. An enhanced distractor interference with increasing memory difficulty is incompatible with the Perceptual Load Theory (Cartwright-Finch & Lavie, 2007; Forster & Lavie, 2007; Handy & Mangun, 2000; Huang-Pollock et al., 2002; Lavie, 1995; Lavie et al., 2014; Lavie & Cox, 1997; Lavie & Tsai, 1994). Here, the observed scheme clearly goes in line with the Cognitive Load Theory. When the task is really easy (low memory task difficulty in musicians), cognitive resources are not fully occupied by the memorization process and are available to suppress both easy and hard-to-ignore distractors. When the task gets more difficult (high memory task difficulty in musicians or low memory task difficulty in non-musicians), there are less resources available to filter out correctly hard-to-ignore distractors, but still enough to suppress easy-to-ignore distractors. When the task is really hard (high memory task difficulty in non-musicians), there are no spare resources to filter out distractors, irrespective of their difficulty. In the last experiment, we test more directly this account of MEMAT findings in terms of the Cognitive Load Theory.

Experiment 3: MEMAT-2, arbitrate between cognitive or perceptual load

Can we explain the interaction between attention and WM during sound sequence encoding with the **Cognitive** Load Theory or with the **Perceptual** Load Theory? Experiment 2 already provides evidence in line with the cognitive load theory. In order to test more directly this question, we administered to non-musician participants an alternative version of MEMAT with only the Memory task, and a new condition with no distracting melody.

In the case of the **Cognitive** Load Theory, we expect, in the high memory task difficulty, better performance in the absence than in the presence of distracting information, since there would be fewer resources available to inhibit even easy-to-ignore distractors.

On the contrary, in the case of the **Perceptual** Load Theory, we predict, in the high memory task difficulty, similar performance in the absence or presence of distracting information, since there would be few resources available to process distractors.

Methods

Participants

Sixteen paid non-musician participants (all right-handed, 5 men and 11 women, aged 19-28 years) participated in this third experiment. Participants were considered as non-musicians as they never practiced any instrument or singing outside compulsory educative programs. They were matched with previous non-musician participants (Experiment 1) in terms of school education, age, laterality and sex (see Table 1) so that results are comparable between Experiments 1 and 3. None of them took part in Experiment 1.

All participants were free from neurological or psychiatric disorder and had normal hearing and normal or corrected-to-normal vision. All subjects gave their written informed consent to participate. Experimental procedures were approved by the appropriate regional ethics committee.

Neuropsychological tests and questionnaires

Participants were asked to perform the same subtests of the WAIS and questionnaires as in Experiments 1 and 2 (forward, backward, and ascending digit span, arithmetic, codes, and symbols; and ASRS, HAD). There is no difference between participants of Experiments 1 and 2 on these WAIS subtests and questionnaires (see Table 1).

Materials

The same materials as in Experiments 1 and 2 were used in MEMAT-2. The same melodies were used for the new condition without distracting tones (no DIS).

Attention manipulation

As in MEMAT-1, S1 and DIS melodies are interleaved and not played simultaneously, in order to avoid masking effect between melodies. S1 is played in the indicated ear, and DIS is played in the other ear, each tone one after the other. The first sound to be played is the first sound of S1, and the last sound to be played is the last sound of DIS.

In MEMAT-2, the DIS melodies can be absent (no DIS), rather easy (easy DIS), or hard (hard DIS) to filter. Participants are informed of the difficulty of the distraction at the beginning of each block (block design), which was not the case in MEMAT-1. When distractor sounds are absent, S1 sounds are separated from one another by 250ms silent intervals, so that the rhythm of S1 does not change between no DIS, easy DIS, and hard DIS conditions. As in MEMAT-1, an easy DIS melody is composed of sounds in a frequency range separated by 6 to 7 semi-tones from the corresponding S1 melody frequency range. A hard DIS melody frequency range is the same than the corresponding S1 melody frequency range. DIS melodies follow the same rules as S1 melodies, as described above.

Memory Task

In MEMAT-2, participants perform only one task, which is the Memory task described for MEMAT-1 above.

Procedure

As in Experiments 1 and 2, participants are seated in a comfortable armchair in a sound-attenuated room, at ~75cm distance from the screen. All stimuli are delivered using Presentation software (Neurobehavioral Systems, Albany, CA, USA). Sounds are delivered through a set of headphones. First, participants have to fill in several questionnaires and undergo an audiogram. Second, they do the training for all block types (n=8 trials per training block). Training melodies (S1, DIS, and S2) are specific to the training sessions. Third, they perform the experimental blocks, in the same order as the training. The main difference from MEMAT-1 here is that they are informed not only of the difficulty of the task but also of the difficulty to ignore the distractors, at the beginning of each block. Trials last at most 8800ms, leading to three-minute-long memory blocks.

Balancing – within blocks

All the combinations of ear of interest (Left or Right) and associated answer (same or different) are equiprobable within a block (6 trials/block each), and for different trials the direction of the change (ascendant or descendant frequencies) is equiprobable (including for each ear of interest).

Balancing – between blocks

Participants perform 6 blocks (24 trials each), in which the task difficulty (low-M and high-M) and the difficulty of the distractor (no DIS, easy DIS, and hard DIS) are kept constant. They are informed of difficulty levels of both memory task and distractors. Please note that in MEMAT-2 the distractor difficulty is balanced between blocks rather than within block (MEMAT-1), to avoid mixing trials with and without distracting melodies.

The same S1 melodies are used in all blocks. However, the answer, the direction of the change when different and the ear of presentation for a given melody are balanced across blocks. The order of the blocks (Latin square) and the melody set for S1 and DIS (for half of the participants, S1 and DIS melodies are switched) are balanced across subjects.

Statistical Analysis

Similar statistical analyses as in Experiment 1 were conducted on the new non-musician group data. For the Bayesian repeated measure ANOVAs, the factor DISdiff has an additional level, leading to three levels: no DIS, easy DIS, hard DIS, and the factor TASK does not apply anymore.

The main objective of MEMAT-2 was to compare the condition no DIS and easy DIS, under high memory task difficulty in particular. To this aim, we planned and performed a Bayesian paired sample t-test comparing these two conditions under high memory task difficulty.

We also performed a Bayesian ANOVA to compare RT and d' in the Memory task between MEMAT-1 and MEMAT-2, to assess whether the small change in task design (with distractor filtering difficulty being randomized within blocks in MEMAT-1 and fixed within blocks in MEMAT-2, and the introduction of blocks without distractors in MEMAT-2) had any impact on performance. Only conditions common to both tasks were analyzed, the Bayesian ANOVA thus had the following factors: DISdiff as a within-group factor (difficulty of the distractors, two levels: easy DIS and hard DIS), MEMdiff as a within-group factor, and EXP (Experiment, two levels: 1 or 3) as a between-group factor. As in Experiments 1 and 2, post-hoc tests are Bayesian t-tests.

Results – MEMAT 2, non-musician participants

Main Results

For d' (Figure 4-A, SupTables S21a and S21b), the best model explaining all Memory results of MEMAT-2 in non-musicians is composed of the factors MEMdiff and DISdiff ($BF_{10} = 1.8e+11$), with decisive evidence for both MEMdiff ($BF_{inclusion} = 3.5e+6$) and DISdiff factors ($BF_{inclusion} = 1.6e+7$). Participants are more accurate in the low memory task difficulty than in the high memory task difficulty. They are more accurate in the no DIS than in the easy DIS ($BF_{10} = 512.7$), in the easy DIS than in the hard DIS ($BF_{10} = 55.7$), and in the no DIS than in the hard DIS ($BF_{10} = 40887.5$) conditions.

As planned, we also statistically compared d' in the no DIS and easy DIS conditions under high memory task difficulty, enabling us to conclude in favor of one of our two hypotheses. We found positive evidence for a larger d' in no DIS than in easy DIS conditions under high memory task difficulty ($BF_{10} = 14.1$), showing a strong distractor interference under high memory load, in line with the Cognitive Load Theory.

For the criterion, all values are superior or equal to zero (see SupTable S4). The best model explaining results from MEMAT-2 in non-musicians includes MEMdiff ($BF_{10} = 135.3$). There is decisive evidence for MEMdiff effect ($BF_{inclusion} = 140.7$): criterion is higher under high memory task difficulty than under low memory task difficulty. There is positive evidence for no effect of DISdiff ($BF_{inclusion} = 0.3$) and for no effect of the interaction between MEMdiff and DISdiff ($BF_{inclusion} = 0.3$) (see Sup.Tables S22a et S22b).

For RTs (Figure 4-B), the best model explaining results from MEMAT-2 in non-musicians is the one composed of the factor DISdiff ($BF_{10} = 40.0$, see Sup.Table S23a). There is strong evidence for a DISdiff effect ($BF_{inclusion} = 39.6$), and positive evidence for no effect of MEMdiff ($BF_{inclusion} = 0.2$). There is positive evidence for longer RTs in the hard DIS than in the no DIS ($BF_{10} = 5.7$) and easy DIS ($BF_{10} = 7.8$) conditions, and there is positive evidence for no difference between no DIS and easy DIS conditions ($BF_{10} = 0.2$) (see Sup.Table S23b).

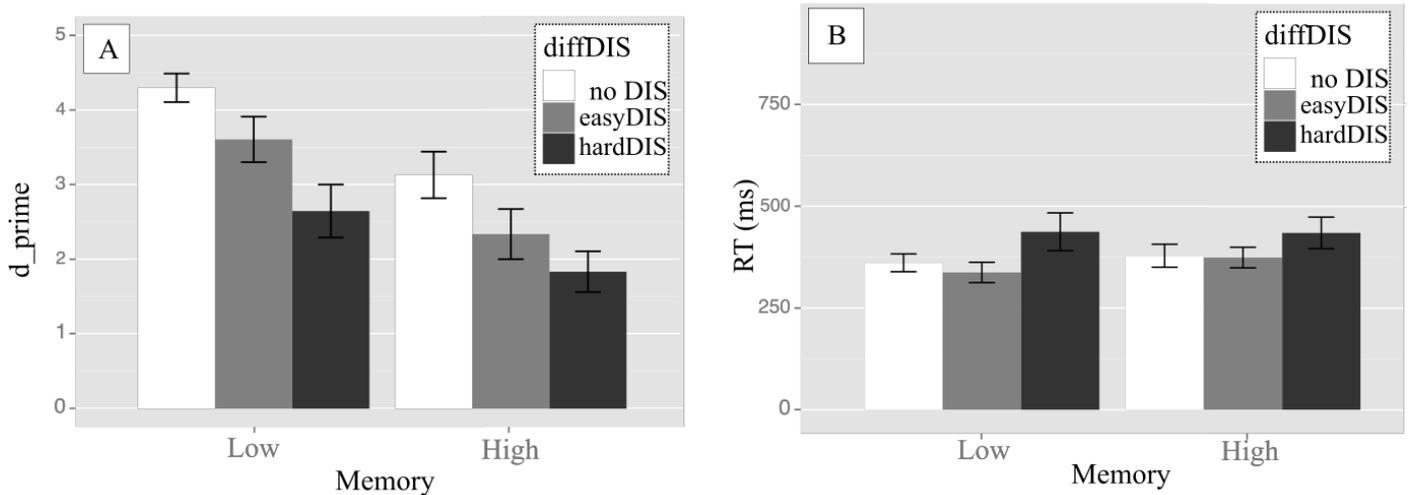


Figure 4 - Behavioral results of MEMAT-2, non-musician participants. Effects of the distraction and task difficulty levels on d -primes (A) and RTs (B). Bars represent standard error of the mean.

Comparison between MEMAT-1 (in non-musicians) and MEMAT-2

For d' (see Sup.Tables S24a and S24b), the best model explaining both MEMAT-1 and MEMAT-2 results in non-musicians is composed of factors MEMdiff and DISdiff and their interaction ($BF_{10}=6.4e+9$). There is decisive evidence for both MEMdiff ($BF_{inclusion}=1.5e+7$) and DISdiff effect ($BF_{inclusion}=4442.8$), and weak evidence for an effect of their interaction ($BF_{inclusion}=1.3$). Also, there is positive evidence for no EXP effect ($BF_{inclusion}=0.2$), and no evidence for all interactions with the factor EXP ($BF_{inclusion}\leq 0.4$; see Sup.Table S24b).

For RTs (see Sup.Tables S25a and S25b), the best model explaining both MEMAT-1 and MEMAT-2 results on non-musicians is composed of factors EXP and DISdiff only ($BF_{10}=2139.2$). There is positive evidence for EXP effect ($BF_{inclusion}=9.3$): participants were faster in MEMAT-2. There is no evidence for any interaction with the factor EXP ($BF_{inclusion}\leq 0.4$; see Sup.Table S25b).

Discussion

We found better performance in the absence of distractors compared to the presence of easy-to-ignore distractors, including under high memory load. This result underlines a strong distractor interference under high memory load and the requirement of cognitive resources to inhibit the easy-to-ignore distractors. Therefore, this finding does not fit with the Perceptual Load Theory which predicts powerful irrelevant information filtering under high load, and clearly goes in line with the **Cognitive** Load Theory (Lavie et al., 2004; Lavie, 2005; Yi et al., 2004).

Statistical analyses reveal no evidence for an impact of the experiment (MEMAT-1 vs. MEMAT-2) on d' . However, the interaction between DISdiff and MEMdiff present in MEMAT-1 was not observed when analyzing the results of MEMAT-2 alone. This can be explained by the change of information given to the participant. In MEMAT-1, participants were aware of the difficulty of the task only, whereas in MEMAT-2, they were aware of both task and distractor difficulties, preventing from surprise and confusion in the absence of the distracting melody, but enabling them to develop better strategies or put more effort to filter hard distractors in the dedicated block. This could also explain the differences in terms of reaction times between MEMAT-1 and MEMAT-2. Yet, there is no evidence towards a difference between experiments in terms of d' , and no change in the overall shape of the results, as there is still a numerically greater difference between hard and easy DIS under low memory task difficulty than in the high memory task difficulty.

General Discussion

MEMAT paradigm allows us to study attention, working memory (WM), and their interaction during encoding, using auditory non-verbal stimuli. As d' is reduced with increasing difficulty of the distractor filtering and of the task, both manipulations impacted performance as predicted. The isolated impact of distractors on perception can be measured in the Perception task (whatever its difficulty), the impact of memory difficulty independently of any attentional filtering processes can be assessed in the Memory task in the absence of distractor, and the interaction between attention and WM can be evaluated in the Memory task in the presence of distractors.

In non-musicians, an impact of the memory task difficulty on the size of the distractor difficulty cost points at shared resources between attention and WM processes. Better performance in the absence of distractors compared to the presence of easy-to-ignore distractors, especially under higher memory task difficulty, is in agreement with the Cognitive Load Theory (i.e., shared cognitive resources between attention and WM). The pattern of results in musician participants, which show enhanced auditory WM skills confirmed that when the memory task difficulty is lower, more cognitive resources are available to efficiently filter out distracting melodies. However, musicianship is associated to considerably enhanced WM performance in the auditory non-verbal domain but has less impact on distractor difficulty cost. This result pattern suggests some separate attention and WM processes, in addition to the common cognitive resources highlighted above.

Shared resources between Attention and Working Memory: Perceptual Load Theory and Cognitive Load theory

Perceptual and Cognitive Load Theories allow to disentangle mechanisms internal to selective attention (Wenger & Fitousi, 2010). The Perceptual Load Theory proposes the automatic exclusion of irrelevant information in conditions of high perceptual load, *i.e.* when all perceptual resources are devoted to relevant information processing (Cartwright-Finch & Lavie, 2007; Forster & Lavie, 2007; Handy & Mangun, 2000; Huang-Pollock et al., 2002; Lavie, 1995; Lavie et al., 2014; Lavie & Cox, 1997; Lavie & Tsal, 1994); whereas the Cognitive Load Theory suggests the active inhibition of irrelevant information with the help of a cognitive mechanism requiring cognitive resources, only available under low cognitive load (Lavie et al., 2004; Lavie, 2005; Yi et al., 2004). These non-exclusive theories propose two different modes for filtering out distractors. Importantly, according to the Perceptual

Load Theory, increasing perceptual load results in reduced distractor interference; whereas according to the Cognitive Load Theory, increasing cognitive load leads to enhanced distractor interference.

In the present study, in non-musicians, under high memory task difficulty (therefore under high memory load) a lack of difference in performance between distracting sound difficulties is observed, while higher d 's are found in the absence of distractor. This result suggests that the increased difficulty in the WM process leads to less available cognitive resources for attention processes, *i.e.*, filtering out of distracting sounds irrespective of their difficulty, in line with the Cognitive Load Theory. This result further suggests that the filtering out of the distractors in MEMAT rather relies on an active suppression mechanism requiring cognitive resources, than on an automatic inhibition as suggested by the Perceptual Load Theory.

Moreover, their better WM skills allow musicians to have no difficulty to filter all distractors in the low memory task difficulty. Filtering of irrelevant sounds gets harder for musicians only when the memory task difficulty is high (therefore, when the WM load is high). This can be explained by their ability to do the memory task using less cognitive resources than non-musicians, allowing them to easily filter distractors in the low memory task difficulty. Their performance in the high memory task difficulty is then similar to the performance of non-musicians in the low memory task difficulty condition. These findings confirm that the memory task difficulty manipulation in MEMAT is rather a cognitive load manipulation, as are classic load manipulation increasing the number of items to memorize. It also shows that increasing the WM load of the task reduces the inhibition of distractors, in line with the Cognitive Load Theory, and are in agreement with previous visual (Lee et al., 2007; Moray, 1967; Yi et al., 2004) and auditory (Schröger, 1996) studies. Importantly, this finding extends the Cognitive Load Theory to the encoding of non-verbal auditory material.

Consequently, in MEMAT, the distractor difficulty cost can be considered as an indicator of the quantity of cognitive resources available for active attentional filtering mechanisms: when the difference between hard- and easy-to-ignore distractors is important, it means that there are still some available resources for filtering in the easy DIS condition. When this difference is reduced, it can be because in both conditions, there are no resources left (as in the high memory task difficulty condition for non-musicians), or because there are enough resources to inhibit all distractors (as in the low memory task difficulty condition, in musicians, see also below).

One reason that could explain why the present data are in line with the Cognitive Load Theory is that the MEMAT paradigm puts participant in an overall low perceptual load. Indeed, in studies revealing how perceptual load determines failure or success of selective attention, all relevant and irrelevant information were presented in the same stream in the high load condition, in studies mostly conducted in the visual modality (Johnson et al., 2002; Lavie, 1995; Wilson et al., 2008). In our case, pieces of information are indeed intricated but not overlapping, leading to easier discrimination between relevant and irrelevant information.

Attention and Working Memory in musicians

In agreement with numerous previous studies, our results show that musicians have better performance than non-musicians in terms of WM for musical stimuli (Ding et al., 2018; George & Coch, 2011; Kishon-Rabin et al., 2011; Tierney et al., 2008), in particular when the memory task is difficult. Results from the perception task also reveal better pitch discrimination performance for musicians compared to non-musicians, which is coherent with previous studies (Ding et al., 2018; George & Coch, 2011; Pallesen et al., 2010; Tierney et al., 2008). MEMAT allows us to add that these superior pitch discrimination and WM abilities are present even with irrelevant stimuli to filter.

Importantly, there was no major difference between musicians and non-musicians in terms of attention filtering. Previous research has however pointed out better selective attention in musicians, especially in the auditory domain (Baumann et al., 2008; Strait & Kraus, 2011), but it appears that these enhanced performance are correlated with overall improvement in cognitive tasks (Strait et al., 2010), and are very likely to depend on WM enhancement (Clayton et al., 2016). Improvement of WM would “leave room” for better attentional processes (see also the previous paragraph). This allows us to underline that attention and WM are at least partly distinct processes, with only superior WM skills in musician participants, and attentional filtering skills within the normal range. We can thus tentatively speculate that musicianship is associated to better encoding strategies for musical material (e.g., within a tonal loop, as proposed by Schulze et al., 2011, involving in particular contour encoding processes, Talamini et al., 2021), but at a level of processing that is fairly independent from cognitive resources shared with attentional processes.

Specificities and usefulness of the MEMAT paradigm

WM and attention are very intricate processes. Only a few studies have tried disentangling them, and rarely so in the auditory domain. Especially, very few paradigms have been designed to manipulate both of them in an independent way. Delayed-Matching-to-Sample paradigms combined with selective speech-in-noise tasks might recruit specific language processing networks (Berouti et al., 1979; Rottschy et al., 2012), and paradigms combining auditory and visual modalities (Meck, 1984; Ward, 1982) might recruit several perceptual and integrative systems. With this new MEMory and ATtention (MEMAT) paradigm, we propose here a way to manipulate attention and WM using simple melodies.

MEMAT allows a new point of view for studying the interaction between selective attention and WM. It is based on a WM task requiring the involvement of attentional processes during encoding, but not on a dual task. In dual tasks, participants typically have to perform a WM task, and an attentional interfering task during the retention period. Results show an increase of distractor interference under high (vs. low) load in the concurrent WM task (Dalton et al., 2009). Some intricate dual task paradigms such as the one from Huang et al. (2013) requires participants to answer to specific targets (selective attention manipulation) either right after their presentation or a certain number of items after their presentation (low/high load). In this task, the hit rate decreased with load, with the difference between no interference and interference being significant only under high load. These paradigms allow to look at attentional performances under WM load *during the retention period*, whereas MEMAT allows to measure the impact of distracting stimuli on WM performance *during encoding*. The results of these two dual task studies are coherent with the results we obtained in the musician group: there is indeed a greater impact of the difficulty of the distractors under high memory load encoding (high memory task difficulty) than under low memory load encoding (low memory task difficulty). In MEMAT we also observe a difference in performance between easy- and hard-to-ignore distractors under low memory load, which might be due to differences in task difficulties across studies or it might be more challenging to call for attentional processing in the encoding phase of a memory task than in the retention phase.

The attention manipulation in MEMAT is based on auditory spatial stream segregation, in which two competing streams are presented in the two ears. A potential limitation could be that streaming would be more difficult in the condition with hard-to-ignore distractors, given the pitch similarity between S1 and distractors in this case. However, it has been shown that spatial stream segregation can be performed on competing sequence of sounds of same frequencies separated by as little as 10° (Middlebrooks & Onsan, 2012; Middlebrooks & Waters, 2020). In MEMAT, the spatial segregation of the S1 and DIS melodies, played one in each ear, allows participants to individualize the melodies, even when their frequency ranges are similar.

The behavioral results obtained in this study point towards an interaction between attention filtering and WM. This seem promising for further electrophysiological or brain imaging enquiries, for which MEMAT is particularly well designed. Indeed, each melody is used once for each condition (low or high difficulty of the task, easy or hard distractor, presentation to the left or the right ear, presentation as a target or as a distractor) which allows all kinds of comparison between conditions. Both attention and WM involve frontal and temporal lobes (Albouy et al., 2013; Awh & Jonides, 2001; Bidet-Caulet et al., 2010) and impact on the amplitude of the N1 evoked response (Albouy et al., 2013; Awh & Jonides, 2001; Campbell et al., 2007). Further experiments are thus needed to explore the interaction between attention and WM during encoding in terms of cerebral correlates. It will be interesting to uncover the neural correlates for these two essential cognitive processes when they are manipulated during sound sequence encoding, allowing us on a longer term to specify how, when, and where attention and WM interact in the healthy brain and in populations of patients. If a brain mechanism is involved in both Attention and WM, impact of both difficulty of the distractor and difficulty of the task should be similar on the related brain responses. Among other things, this paradigm can also help us to understand the impact of distraction during encoding on the cognitive effort during the retention period. Neurophysiological investigations using MEMAT should bring interesting insight into the shared and separate mechanisms of attention filtering and WM.

Conclusion

To sum up, the MEMAT paradigm allows us to study the impact of WM load on attention filtering, and vice-versa, during sound sequence encoding, emphasizing the role of shared cognitive resources between WM and attention. The use of non-verbal auditory stimuli will allow for example further experiments along the course of development in children, without the confounding factor of verbal skills. The MEMAT paradigm has also been specifically designed to be used in neuroimaging experiments, thus allowing for an investigation of attention, WM, and their interaction at the neurophysiological level.

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Supplementary data

I. MEMAT-1, non-musicians

d'

ANOVA on d' – non-musicians, MEMAT-1, Memory and Perception tasks, with TASK, TASKdiff and DISdiff as factors

M & P	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 non-musicians	Null model (incl. subject)	0.053	3.4e -12	6.1e -11	1.0	
	task	0.053	6.833e -12	1.2e -10	2.0	1.1
	TASKdiff	0.053	3.4e -7	6.1e -6	100965.7	2.3
	task + TASKdiff	0.053	1.3e -6	2.4e -5	388657.8	2.4
	task+TASKdiff+task* TASKdiff	0.053	5.1e -7	9.2e -6	151676.9	1.4
	DISdiff	0.053	7.2e -9	1.3e -7	2142.3	1.7
	task + DISdiff	0.053	2.3e -8	4.1e -7	6705.1	5.6
	TASKdiff + DISdiff	0.053	1.2e -2	0.2	3.6e +9	3.1
	task + TASKdiff + DISdiff	0.053	0.1	1.9	2.8e +10	2.2
	task + TASKdiff + DISdiff + task * TASKdiff	0.053	4.2e -2	0.8	1.2e +10	1.9
	task + DISdiff + task * DISdiff	0.053	5.7e -9	1.0e -7	1682.2	3.0
	task + TASKdiff + DISdiff + task * DISdiff	0.053	2.4e -2	0.4	7.1e +9	4.3
	task + TASKdiff + DISdiff +task* TASKdiff +task*DISdiff	0.053	1.1e -2	0.2	3.3e +9	1.6
	TASKdiff + DISdiff + TASKdiff * DISdiff	0.053	3.9e -2	0.7	1.2e +10	15.6
	task + TASKdiff + DISdiff + TASKdiff * DISdiff	0.053	0.4	13.6	1.3e +11	4.1
	task + TASKdiff + DISdiff + task * TASKdiff + TASKdiff * DISdiff	0.053	0.2	4.0	5.5e +10	3.7
	task + TASKdiff + DISdiff + task * DISdiff + TASKdiff *DISdiff	0.053	0.1	2.0	3.0e +10	9.8
	task + TASKdiff + DISdiff + task * TASKdiff +task*DISdiff + TASKdiff * DISdiff	0.053	4.9e -2	0.9	1.5e +10	4.5
task + TASKdiff + DISdiff + task * TASKdiff +task*DISdiff + TASKdiff * DISdiff + task * TASKdiff * DISdiff	0.053	1.5e -2	0.3	4.4e +9	5.3	

Sup.Table S1a - Bayesian ANOVA results for d' , non-musicians, MEMAT-1 (factors: task, TASKdiff, DISdiff).

M & P		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 non-musicians	d'	task	0.263	0.5	10.3
		TASKdiff	0.263	0.1	3.7e+6
		DISdiff	0.263	0.1	6.9e+4
		task * TASKdiff	0.263	0.3	0.4
		task * DISdiff	0.263	0.2	0.2
		TASKdiff * DISdiff	0.263	0.8	4.4
		task * TASKdiff * DISdiff	0.053	1.5e-2	0.3

Sup. Table S1b - Analysis of effects for d', non-musicians, MEMAT-1, Perception and Memory Tasks (factors: task, TASKdiff, DISdiff).

ANOVA on d' - non-musicians, MEMAT-1, Memory task, with MEMdiff and DISdiff as factors

MEMORY		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 non-musicians	d'	Null model (incl. subject)	0.200	9.8e-9	3.9e-8	1.0	X
		MEMdiff	0.200	1.6e-4	6.4e-4	16303.2	2.2
		DISdiff	0.200	5.0e-7	2.0e-6	51.5	0.9
		MEMdiff + DISdiff	0.200	0.2	1.3	2.5e+7	1.2
		MEMdiff + DISdiff + MEMdiff * DISdiff	0.200	0.8	12.2	7.7e+7	1.5

Sup. Table S2a - Bayesian ANOVA results for d', non-musicians, MEMAT-1, Memory Task only (factors: MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 non-musicians	d'	MEMdiff	0.400	0.2	479107.6
		DISdiff	0.400	0.2	1542.3
		MEMdiff * DISdiff	0.200	0.8	3.1

Sup. Table S2b - Analysis of effects for results on d', non-musicians, MEMAT-1, Memory Task only (factors: MEMdiff, DISdiff).

ANOVA on d' - non-musicians, MEMAT-1, Perception task, with PERdiff and DISdiff as factors

PERCEPTION		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 non-musicians	d'	Null model (incl. subject)	0.200	0.0	0.0	1.0	X
		PERdiff	0.200	0.0	0.1	11.8	1.0
		DISdiff	0.200	0.0	0.1	15.7	0.8
		PERdiff + DISdiff	0.200	0.5	3.9	395.0	1.3
		PERdiff + DISdiff + PERdiff * DISdiff	0.200	0.5	3.6	379.5	10.4

Sup.Table S3a - Bayesian ANOVA results on d' for non-musicians, MEMAT-1, Perception Task only (factors: PERdiff, DISdiff).

PERCEPTION		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 non-musicians	d'	PERdiff	0.400	0.5	24.4
		DISdiff	0.400	0.5	32.0
		PERdiff * DISdiff	0.200	0.5	1.0

Sup.Table S3b - Analysis of effects for results on d' , non-musicians, MEMAT-1, Perception Task only (factors: PERdiff, DISdiff).

Criterion

Criterion data: BF_{10} are extracted from comparison to zero (Bayesian one-sample t-test)

		Study 1 MEMAT 1, non-musicians			Study 2 MEMAT 1, musicians			Study 3 MEMAT 2, non-musicians		
		mean	SD	BF_{10}	mean	SD	BF_{10}	mean	SD	BF_{10}
Low Perception	Easy DIS	0.2	0.5	0.8	$-5.9e-2$	0.2	0.5			
	Hard DIS	0.1	0.4	0.4	$1.0e-2$	0.2	0.3			
High Perception	Easy DIS	0.6	0.6	25.4	0.3	0.5	2.4			
	Hard DIS	0.3	0.7	0.7	$-8.6e-4$	0.4	0.3			
Low Memory	No DIS							0.1	0.2	0.4
	Easy DIS	-0.1	0.4	0.5	-0.1	0.3	0.5	0.3	0.3	9.4
	Hard DIS	-0.2	0.5	1.6	-0.2	0.4	1.2	$-0.2e-2$	0.6	0.3
High Memory	No DIS							0.4	0.5	6.5
	Easy DIS	0.4	0.4	27.9	$4.7e-2$	0.2	0.4	0.4	0.5	10.3
	Hard DIS	0.2	0.4	0.9	$3.5e-2$	0.4	0.3	0.4	0.4	22.0

Sup. Table S4 - Criterion data (mean, SD: standard deviation) on all experiments (MEMAT-1 non-musicians, MEMAT-1 musicians, MEMAT-2 non-musicians) and all crossed conditions (task, TASKdiff and DISdiff). BF_{10} are extracted from Bayesian one-sample test comparison to zero.

ANOVA on c - non-musicians, MEMAT-1, Memory and Perception tasks, with task, TASKdiff and DISdiff as factors

M & P	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 non-musicians c	Null model (incl. subject)	0.053	3.1e-5	5.7e-4	1.0	
	TASK	0.053	1.1e-4	0.2e-2	3.6	6.9
	TASKdiff	0.053	2.3e-2	0.4	726.8	1.4
	TASK + TASKdiff	0.053	0.1	2.5	3921.7	5.9
	TASK + TASKdiff + TASK * TASKdiff	0.053	0.1	1.2	1953.0	1.6
	DISdiff	0.053	4.8e-5	8.6e-4	1.5	1.2
	TASK + DISdiff	0.053	1.7e-4	0.3e-2	5.4	1.4
	TASKdiff + DISdiff	0.053	4.7e-2	0.9	1505.1	2.7
	TASK + TASKdiff + DISdiff	0.053	0.3	7.1	8957.2	3.9
	TASK + TASKdiff + DISdiff + TASK * TASKdiff	0.053	0.2	3.3	4894.8	2.6
	TASK + DISdiff + TASK * DISdiff	0.053	5.8e-5	0.1e-2	1.8	22.4
	TASK + TASKdiff + DISdiff + TASK * DISdiff	0.053	0.1	1.3	2155.1	2.2
	TASK + TASKdiff + DISdiff + TASK * TASKdiff + TASK * DISdiff	0.053	3.8e-2	0.7	1219.5	2.8
	TASKdiff + DISdiff + TASKdiff * DISdiff	0.053	1.5e-2	0.3	469.7	1.6
	TASK + TASKdiff + DISdiff + TASKdiff * DISdiff	0.053	0.1	1.8	2936.6	4.3
	TASK + TASKdiff + DISdiff + TASK * TASKdiff + TASKdiff * DISdiff	0.053	0.1	1.0	1687.1	3.7
	TASK + TASKdiff + DISdiff + TASK * DISdiff + TASKdiff * DISdiff	0.053	2.4e-2	0.5	778.0	8.3
	TASK + TASKdiff + DISdiff + TASK * TASKdiff + TASK * DISdiff + TASKdiff * DISdiff	0.053	1.3e-2	0.2	407.4	3.5
	TASK + TASKdiff + DISdiff + TASK * TASKdiff + TASK * DISdiff + TASKdiff * DISdiff + TASK * TASKdiff * DISdiff	0.053	0.4e-2	0.1	139.6	3.9

Sup. Table S5a - Bayesian ANOVA results on criterion (c) for non-musicians, MEMAT-1, Memory and Perception Tasks (factors: TASK, TASKdiff, DISdiff).

M & P		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 non-musicians	c	TASK	0.263	0.5	5.9
		TASKdiff	0.263	0.5	1297.1
		DISdiff	0.263	0.5	2.3
		TASK * TASKdiff	0.263	0.3	0.5
		TASK * DISdiff	0.263	0.1	0.2
		TASKdiff * DISdiff	0.263	0.2	0.3
		TASK * TASKdiff * DISdiff	0.053	0.4e-2	0.3

Sup.Table S5b - Analysis of effects for results on criterion (c), non-musicians, MEMAT-1, Perception and Memory Tasks (factors: TASK, TASKdiff, DISdiff).

ANOVA on c - non-musicians, MEMAT-1, Memory task, with MEMdiff and DISdiff as factors

M		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 non-musicians	c	Null model (incl. subject)	0.2	1.7e-4	7.0e-4	1.0	X
		MEMdiff + DISdiff	0.2	0.4	3.2	2550.7	2.0
		MEMdiff	0.2	0.4	2.7	2287.0	1.2
		MEMdiff + DISdiff + MEMdiff * DISdiff	0.2	0.2	0.7	885.8	2.1
		DISdiff	0.2	1.3e-4	5.3e-4	0.8	1.7

Sup.Table S6a - Bayesian ANOVA results on criterion (c) for non-musicians, MEMAT-1, Memory Task (factors: MEMdiff, DISdiff).

M		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 non-musicians	c	MEMdiff	0.4	0.8	2755.5
		DISdiff	0.4	0.4	1.1
		MEMdiff * DISdiff	0.2	0.2	0.3

Sup.Table S6b - Analysis of effects for results on criterion (c), non-musicians, MEMAT-1, Memory Task (factors: MEMdiff, DISdiff).

ANOVA on c - non-musicians, MEMAT-1, Perception task, with PERdiff and DISdiff as factors

P		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 non-musicians	c	Null model (incl. subject)	0.2	0.2	1.1	1.0	X
		PERdiff	0.2	0.3	1.8	1.5	1.1
		PERdiff + DISdiff	0.2	0.2	1.2	1.1	1.5
		DISdiff	0.2	0.2	0.7	0.7	0.8
		PERdiff + DISdiff + PERdiff * DISdiff	0.2	0.1	0.4	0.5	2.1

Sup.Table S7a - Bayesian ANOVA results on criterion (c) for non-musicians, MEMAT-1, Perception Task (factors: PERdiff, DISdiff).

M		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 non-musicians	c	PERdiff	0.4	0.5	1.5
		DISdiff	0.4	0.4	0.7
		PERdiff * DISdiff	0.2	0.1	0.4

Sup.Table S5b - Analysis of effects for results on criterion (c), non-musicians, MEMAT-1, Perception Task (factors: PERdiff, DISdiff).

RT

ANOVA on RT - non-musicians, MEMAT-1, Memory task, with MEMdiff and DISdiff as factors

MEMORY		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 non-musicians	RT	Null model (incl. subject)	0.200	9.4e -4	0.4e-2	1.0	X
		MEMdiff	0.200	0.2e-2	0.7e-2	1.9	0.8
		DISdiff	0.200	0.2	0.7	164.8	1.4
		MEMdiff + DISdiff	0.200	0.6	6.5	661.0	2.0
		MEMdiff + DISdiff + MEMdiff * DISdiff	0.200	0.2	1.1	236.0	5.7

Sup.Table S8a - Bayesian ANOVA results for results on RT, non-musicians, MEMAT-1, Memory Task only (factors: MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 non-musicians	RT	MEMdiff	0.400	0.6	4.0
		DISdiff	0.400	0.8	283.9
		MEMdiff * DISdiff	0.200	0.2	0.4

Sup.Table S8b - Analysis of effects for results on RT, non-musicians, MEMAT-1, Memory Task only (factors: MEMdiff, DISdiff).

ANOVA on RT - non-musicians, MEMAT-1, Perception task, with PERdiff and DISdiff as factors

PERCEPTION		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 non-musicians	RT	Null model (incl. subject)	0.200	1.7e-2	0.1	1.0	X
		PERdiff	0.200	0.4e-2	1.7e-2	0.3	1.0
		DISdiff	0.200	0.7	8.9	41.0	0.8
		PERdiff + DISdiff	0.200	0.2	0.9	11.0	4.9
		PERdiff + DISdiff + PERdiff * DISdiff	0.200	0.1	0.5	6.2	1.9

Sup.Table S9a - Bayesian ANOVA results for results on RT, non-musicians, MEMAT-1, Perception Task only (factors: PERdiff, DISdiff).

PERCEPTION		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 non-musicians	RT	<i>PERdiff</i>	0.400	0.2	0.3
		DISdiff	0.400	0.9	41.6
		PERdiff * DISdiff	0.200	0.1	0.6

Sup.Table S9b - Analysis of effects for results on RT, non-musicians, MEMAT-1, Perception Task only (factors: PERdiff, DISdiff).

II. MEMAT-1, musicians

d'

ANOVA on d' - musicians, MEMAT-1, Memory and Perception tasks, with TASK,

TASKdiff and DISdiff as factors

M & P	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 musicians	Null model (incl. subject)	0.053	0.4e-2	0.1	1.0	X
	TASK	0.053	0.3e-2	4.7 e-2	0.7	0.9
	TASKdiff	0.053	1.3e-2	0.2	3.2	0.8
	TASK + TASKdiff	0.053	0.9 e-2	0.2	2.3	2.3
	TASK+TASKdiff +TASK*TASKdiff	0.053	0.4 e-2	0.1	1.0	3.1
	DISdiff	0.053	4.3 e-2	0.8	11.0	0.9
	TASK + DISdiff	0.053	3.2 e-2	0.6	8.1	1.8
	TASKdiff + DISdiff	0.053	0.2	4.9	54.3	14.3
	TASK + TASKdiff + DISdiff	0.053	0.2	3.2	38.8	5.2
	TASK + TASKdiff + DISdiff + TASK * TASKdiff	0.053	0.1	1.4	17.9	7.5
	TASK + DISdiff +TASK * DISdiff	0.053	0.9 e-2	0.2	2.2	3.9
	TASK + TASKdiff + DISdiff + TASK * DISdiff	0.053	3.9 e-2	0.7	9.9	2.8
	TASK + TASKdiff + DISdiff + TASK * TASKdiff + TASK * DISdiff	0.053	1.7 e-2	0.3	4.2	2.2
	TASKdiff + DISdiff + TASKdiff * DISdiff	0.053	0.1	3.1	37.1	1.9
	TASK + TASKdiff + DISdiff + TASKdiff * DISdiff	0.053	0.1	2.7	33.0	6.1
	TASK + TASKdiff + DISdiff + TASK * TASKdiff + TASKdiff * DISdiff	0.053	0.1	1.1	14.5	3.3
	TASK + TASKdiff + DISdiff + TASK * DISdiff + TASKdiff *DISdiff	0.053	3.3 e-2	0.6	8.4	5.3
TASK + TASKdiff + DISdiff + TASK * TASKdiff + TASK * DISdiff + TASKdiff * DISdiff	0.053	1.6 e-2	0.3	4.1	6.0	

		TASK + TASKdiff + DISdiff+ TASK*TASKdiff+TASK*DISdiff + TASKdiff * DISdiff + TASK * TASKdiff * DISdiff	0.053	0.7 e-2	0.1	1.7	4.3
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Sup.Table S10a - Bayesian ANOVA results for results on d' , musicians, MEMAT-1 (factors: TASK, TASKdiff, DISdiff).

M & P	Effects	P(incl)	P(incl data)	BF _{Inclusion}	
MEMAT 1 musicians	d'	TASK	0.263	0.3	0.8
		TASKdiff	0.263	0.4	4.7
		DISdiff	0.263	0.5	15.8
		TASK * TASKdiff	0.263	0.2	0.5
		TASK * DISdiff	0.263	0.1	0.3
		TASKdiff * DISdiff	0.263	0.4	0.8
		TASK * TASKdiff * DISdiff	0.053	0.7e-2	0.4

Sup.Table S10b - Analysis of effects for results on d' , musicians, MEMAT-1, Perception and Memory Tasks (factors: TASK, TASKdiff, DISdiff).

ANOVA on d' - musicians, MEMAT-1, Memory task, with MEMdiff and DISdiff as factors

MEMORY	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %	
MEMAT 1 musicians	d'	Null model (incl. subject)	0.200	0.1	0.5	1.0	X
		MEMdiff	0.200	0.1	0.2	0.5	1.4
		DISdiff	0.200	0.3	1.9	3.0	1.1
		MEMdiff + DISdiff	0.200	0.2	0.8	1.6	1.8
		MEMdiff + DISdiff + MEMdiff * DISdiff	0.200	0.3	2.1	3.3	8.7

Sup.Table S11a - Bayesian ANOVA results on d' , musicians, MEMAT-1, Memory Task only (factors: MEMdiff, DISdiff).

MEMORY	Effects	P(incl)	P(incl data)	BF _{Inclusion}	
MEMAT 1 musicians	d'	MEMdiff	0.400	0.2	0.5
		DISdiff	0.400	0.5	3.1
		MEMdiff * DISdiff	0.200	0.3	2.0

Sup.Table S11b - Analysis of effects for results on d' , musicians, MEMAT-1, Memory Task only (factors: MEMdiff, DISdiff).

ANOVA on d' - musicians, MEMAT-1, Perception task, with PERdiff and DISdiff as factors

PERCEPTION		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 musicians	d'	Null model (incl. subject)	0.200	0.1	0.2	1.0	X
		PERdiff	0.200	0.2	0.8	3.2	1.3
		DISdiff	0.200	0.1	0.5	2.0	1.5
		PERdiff + DISdiff	0.200	0.5	4.1	9.9	10.6
		PERdiff + DISdiff + PERdiff * DISdiff	0.200	0.2	0.8	3.4	2.1

Sup. Table S12a - Bayesian ANOVA results on d' , musicians, MEMAT-1, Perception Task only (factors: PERdiff, DISdiff).

PERCEPTION		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 musicians	d'	PERdiff	0.400	0.7	4.3
		DISdiff	0.400	0.6	2.8
		<i>PERdiff * DISdiff</i>	<i>0.200</i>	<i>0.2</i>	<i>0.3</i>

Sup. Table S12b - Analysis of effects for results on d' , musicians, MEMAT-1, Perception Task only (factors: PERdiff, DISdiff).

Criterion

ANOVA on c - musicians, MEMAT-1, Memory and Perception tasks, with TASK, TASKdiff and DISdiff as factors

M & P	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 musicians c	Null model (incl. subject)	0.053	2.3e-2	0.4	1.0	X
	TASK	0.053	2.0e-2	0.4	0.9	1.9
	TASKdiff	0.053	0.2	5.2	9.8	1.5
	TASK + TASKdiff	0.053	0.2	4.6	8.9	1.2
	TASK+TASKdiff+TASK*TASKdiff	0.053	0.1	1.1	2.4	4.1
	DISdiff	0.053	1.1 e-2	0.2	0.5	0.8
	TASK + DISdiff	0.053	1.1 e-2	0.2	0.5	3.4
	TASKdiff + DISdiff	0.053	0.1	2.4	5.2	1.9
	TASK + TASKdiff + DISdiff	0.053	0.1	2.5	5.3	3.8
	TASK + TASKdiff + DISdiff + TASK * TASKdiff	0.053	3.2e-2	0.6	1.4	11.6
	TASK+DISdiff +TASK*DISdiff	0.053	0.3e-2	4.7e-2	0.1	2.0
	TASK + TASKdiff + DISdiff + TASK * DISdiff	0.053	3.1e-2	0.6	1.4	2.7
	TASK + TASKdiff + DISdiff +TASK*TASKdiff +TASK*DISdiff	0.053	0.8e-2	0.1	0.3	2.3
	TASKdiff + DISdiff + TASKdiff * DISdiff	0.053	0.1	1.0	2.2	2.2
	TASK + TASKdiff + DISdiff + TASKdiff * DISdiff	0.053	0.1	1.1	2.4	6.6
	TASK + TASKdiff + DISdiff + TASK * TASKdiff + TASKdiff * DISdiff	0.053	1.2e-2	0.2	0.6	4.6
	TASK + TASKdiff + DISdiff +TASK*DISdiff+TASKdiff*DISdiff	0.053	1.4e-2	0.3	0.6	7.0
	TASK + TASKdiff + DISdiff +TASK*TASKdiff+ TASK*DISdiff + TASKdiff * DISdiff	0.053	0.4e-2	0.1	0.2	12.4
TASK + TASKdiff + DISdiff + TASK * TASKdiff + TASK * DISdiff + TASKdiff * DISdiff + TASK * TASKdiff * DISdiff	0.053	0.5e-2	0.1	0.2	2.8	

Sup.Table S13a - Bayesian ANOVA results on criterion (c) for musicians, MEMAT-1, Memory and Perception Tasks (factors: TASK, TASKdiff, DISdiff).

M & P	Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 musicians	TASK	0.263	0.4	1.0
	TASKdiff	0.263	0.7	10.4
	DISdiff	0.263	0.3	0.6
	<i>TASK * TASKdiff</i>	0.263	0.1	0.3
	<i>TASK * DISdiff</i>	0.263	0.1	0.3
	TASKdiff * DISdiff	0.263	0.1	0.4
	TASK * TASKdiff * DISdiff	0.053	0.5e-2	1.5

Sup. Table S13b - Analysis of effects for results on criterion (c), musicians, MEMAT-1, Memory and Perception Tasks (factors: TASK, TASKdiff, DISdiff).

RT

ANOVA on RT - musicians, MEMAT-1, Memory task, with MEMdiff and DISdiff as factors

MEMORY		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 musicians	RT	Null model (incl. subject)	0.200	0.5	4.4	1.0	X
		MEMdiff	0.200	0.2	1.1	0.4	1.9
		DISdiff	0.200	0.2	0.7	0.3	0.9
		MEMdiff + DISdiff	0.200	0.1	0.3	0.1	5.4
		MEMdiff + DISdiff + MEMdiff * DISdiff	0.200	3.1e-2	0.1	0.1	3.3

Sup.Table S14a - Bayesian ANOVA results for results on RT, musicians, MEMAT-1, Memory Task only (factors: MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 musicians	RT	MEMdiff	0.400	0.3	0.4
		<i>DISdiff</i>	<i>0.400</i>	<i>0.2</i>	<i>0.3</i>
		MEMdiff * DISdiff	0.200	3.1e-2	0.5

Sup.Table S14b - Analysis of effects for results on RT, musicians, MEMAT-1, Memory Task only (factors: MEMdiff, DISdiff).

ANOVA on RT - musicians, MEMAT-1, Perception task, with PERdiff and DISdiff factors

PERCEPTION		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 1 musicians	RT	Null model (incl. subject)	0.200	0.6	5.3	1.0	X
		PERdiff	0.200	0.2	0.9	0.3	1.0
		DISdiff	0.200	0.2	0.8	0.3	1.4
		PERdiff + DISdiff	0.200	0.1	0.2	0.1	1.7
		PERdiff + DISdiff + PERdiff * DISdiff	0.200	2.4e-2	0.1	4.2e-2	3.1

Sup.Table S15a - Bayesian ANOVA results for results on RT, musicians, MEMAT-1, Perception Task only (factors: PERdiff, DISdiff).

PERCEPTION		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 1 musicians	RT	<i>PERdiff</i>	<i>0.400</i>	<i>0.2</i>	<i>0.3</i>
		<i>DISdiff</i>	<i>0.400</i>	<i>0.2</i>	<i>0.3</i>
		PERdiff * DISdiff	0.200	2.4e-2	0.4

Sup.Table S15b - Analysis of effects for results on RT, musicians, MEMAT-1, Memory Task only (factors: PERdiff, DISdiff).

III. MEMAT-1, comparison between non-musicians and musicians

d'

ANOVA on d' – non-musicians and musicians, MEMAT-1, Memory task only, with group,

MEMdiff and DISdiff as factors

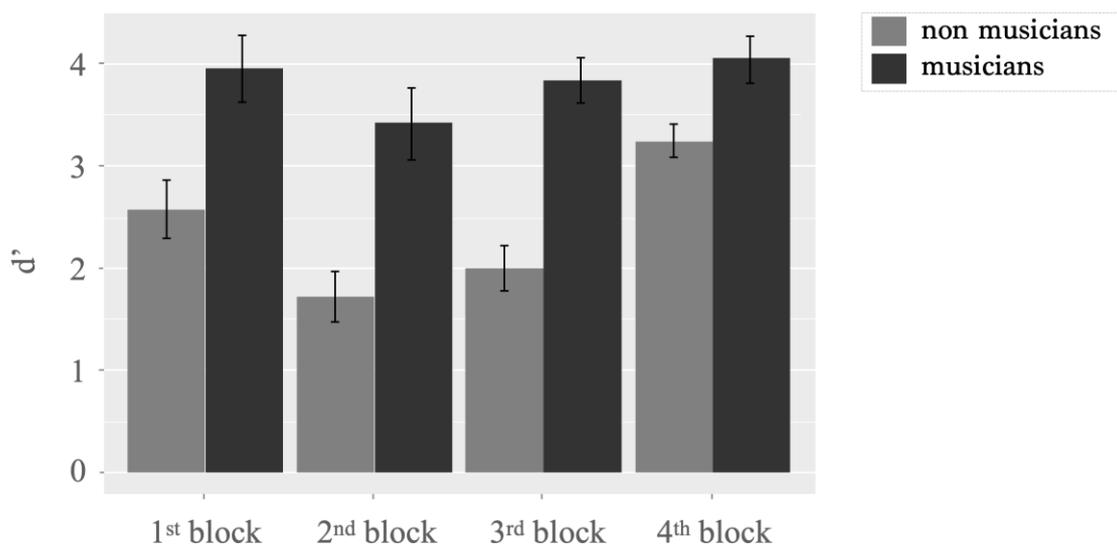
MEMORY	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT-1 non-musicians and musicians	Null model (incl. subject)	0.053	9.8e -14	1.8e -12	1.0	X
	MEMdiff + DISdiff + group + MEMdiff * DISdiff + MEMdiff * group + DISdiff * group + MEMdiff * DISdiff * group	0.053	0.7	42.9	7.2e +12	4.7
	MEMdiff + DISdiff + group + MEMdiff * group + DISdiff * group	0.053	0.1	3.0	1.4e +12	3.5
	MEMdiff + DISdiff + group + MEMdiff * group	0.053	0.1	1.7	8.8e +11	2.6
	MEMdiff + DISdiff + group + MEMdiff * DISdiff + MEMdiff * group + DISdiff * group	0.053	0.04	0.8	4.1e +11	5.6
	MEMdiff + DISdiff + group + MEMdiff * DISdiff + MEMdiff * group	0.053	0.03	0.5	2.6e +11	6.4
	MEMdiff + DISdiff + group + DISdiff * group	0.053	4.9e -4	0.009	5.0e +9	6.5
	MEMdiff + DISdiff + group	0.053	3.8e -4	0.007	3.9e +9	2.5
	MEMdiff + DISdiff + group + MEMdiff * DISdiff + DISdiff * group	0.053	1.3e -4	0.002	1.4e +9	3.22
	MEMdiff + DISdiff + group + MEMdiff * DISdiff	0.053	1.0e -4	0.002	1.1e +9	7.3
	MEMdiff + group + MEMdiff * group	0.053	7.4e -6	1.3e -4	7.5e +7	2.3
	MEMdiff + DISdiff	0.053	8.4e -7	1.5e -5	8.6e +6	1.5
	MEMdiff + DISdiff + MEMdiff * DISdiff	0.053	2.3e -7	4.1e -6	2.3e +6	1.8
	MEMdiff + group	0.053	1.2e -7	2.2e -6	1.3e +6	3.7
	DISdiff + group	0.053	1.8e -8	3.3e -7	187651.2	1.7
	DISdiff + group + DISdiff * group	0.053	1.6e -8	2.8e -7	160080.1	1.9
	MEMdiff	0.053	2.7e -10	4.837e -9	2730.3	0.914
	DISdiff	0.053	4.1e -11	7.430e -10	419.4	0.928
group	0.5e-1	4.1e -11	7.326e -10	413.5	0.918	

Sup.Table S16a - Bayesian ANOVA results for results on d' , non-musicians & musicians, MEMAT-1, Memory Task only (factors: group, MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT-1 non-musicians and musicians	d'	group	0.263	4.8e-4	455.6
		MEMdiff	0.263	8.7e-4	25407.8
		DISdiff	0.263	0.1	11595.4
		group * MEMdiff	0.263	0.3	266.0
		group * DISdiff	0.263	0.2	1.6
		<i>MEMdiff * DISdiff</i>	<i>0.263</i>	<i>0.1</i>	<i>0.3</i>
		group * MEMdiff * DISdiff	0.053	0.7	17.5

Sup.Table S16b - Analysis of effects for results on d', non-musicians & musicians, MEMAT-1, Memory Task only (factors: group, MEMdiff, DISdiff).

ANOVA on d' – non-musicians and musicians, MEMAT-1, Memory task, with group and rank of the block as factors



Sup.Figure 1 - Effects of the group and rank of the block on d-primes. Musicians and non-musicians do not progress in the same way across blocks: non-musician participants have a greater progress rate than musicians, so if anything, between-group differences diminish across blocks. Therefore, it seems unlikely that implicit memory of melodies from previous blocks would favor musician participants.

		Models	P(M)	P(M data)	BF _M	BF ₁₀	error%
MEMAT-1 non-musicians and musicians	d'	Null model (incl. subject)	0.2	1.7e -8	6.8e -8	1.0	
		block_rank + group + block_rank* group	0.2	0.7	11.4	4.4e +7	10.0
		block_rank + group	0.2	0.3	1.4	1.5e +7	1.7
		block_rank	0.2	7.5e -4	0.003	44168.2	0.5
		group	0.2	6.0e -6	2.4e -5	352.7	1.0

Sup.Table 17a - Bayesian ANOVA results for results on d', non-musicians & musicians, MEMAT-1, (factors: group, rank of the block).

		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT-1 non-musicians and musicians	d'	group	0.4	0.3	348.0
		block_rank	0.4	0.3	43589.5
		group * block_rank	0.2	0.7	2.9

Sup.Table 17b - Analysis of effects for results on d', non-musicians & musicians, MEMAT-1, (factors: group, rank of the block).

ANOVA on d' – non-musicians and musicians, MEMAT-1, Perception task only, with group, PERdiff and DISdiff as factors

PERCEPTION	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT-1 non-musicians and musicians	Null model (incl. subject)	0.053	1.0e -7	1.9e -6	1.0	X
	PERdiff + DISdiff + group	0.053	0.4	10.7	3.6e +6	4.0
	PERdiff + DISdiff + group + DISdiff * group	0.053	0.2	3.4	1.5e +6	2.7
	PERdiff + DISdiff + group + PERdiff * group	0.053	0.1	2.9	1.3e +6	2.8
	PERdiff + DISdiff + group + PERdiff * DISdiff	0.053	0.1	2.4	1.1e +6	2.8
	PERdiff + DISdiff + group + PERdiff * group + DISdiff * group	0.053	0.1	1.3	637030.1	8.7
	PERdiff + DISdiff + group + PERdiff * DISdiff + PERdiff * group	0.053	0.1	1.0	505525.4	1.0
	PERdiff + DISdiff + group + PERdiff * DISdiff + DISdiff * group	0.053	0.04	0.9	458870.5	2.5
	PERdiff + DISdiff + group + PERdiff * DISdiff + PERdiff * group + DISdiff * group	0.053	0.02	0.4	184509.5	2.4
	PERdiff + DISdiff + group + PERdiff * DISdiff + PERdiff * group + DISdiff * group + PERdiff * DISdiff * group	0.053	0.02	0.3	154037.0	4.1
	PERdiff + DISdiff	0.053	0.005	0.1	48440.0	3.5
	PERdiff + DISdiff + PERdiff * DISdiff	0.053	0.002	0.03	14922.9	8.8
	PERdiff + group	0.053	0.001	0.02	10199.7	4.3
	DISdiff + group	0.053	9.1e -4	0.02	8656.5	5.3
	PERdiff + group + PERdiff * group	0.053	3.8e -4	0.01	3638.7	5.7
	DISdiff + group + DISdiff * group	0.053	3.5e -4	0.01	3358.3	2.7
	PERdiff	0.053	1.5e -5	2.7e -4	145.6	4.0
	DISdiff	0.053	1.2e -5	2.2e -4	115.0	5.3
group	0.053	7.3e -6	1.3e -4	69.3	5.8	

Sup.Table S18a - Bayesian ANOVA results for results on d' , non-musicians & musicians, MEMAT-1, Perception Task only (factors: group, PERdiff, DISdiff).

PERCEPTION		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT-1 non-musicians and musicians	d'	group	0.263	0.5	473.9
		PERdiff	0.263	0.5	419.1
		DISdiff	0.263	0.5	73.9
		group * PERdiff	0.263	0.3	0.4
		group * DISdiff	0.263	0.3	0.4
		<i>PERdiff * DISdiff</i>	<i>0.263</i>	<i>0.2</i>	<i>0.3</i>
		group * PERdiff * DISdiff	0.053	0.02	0.8

Sup.Table S18b - Analysis of effects for results on d', non-musicians & musicians, MEMAT-1, Perception Task only (factors: group, PERdiff, DISdiff).

RT

ANOVA on RT – non-musicians and musicians, MEMAT-1, Memory task only, with group,

MEMdiff and DISdiff as factors

MEMORY	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT-1 non-musicians and musicians	Null model (incl. subject)	0.053	2.0e -4	0.004	1.0	X
	MEMdiff + DISdiff + group + MEMdiff * group + DISdiff * group	0.053	0.3	8.9	1693.1	3.7
	MEMdiff + DISdiff + group + DISdiff * group	0.053	0.3	7.7	1539.0	3.12
	MEMdiff + DISdiff + group + MEMdiff * DISdiff + MEMdiff * group + DISdiff * group	0.053	0.1	2.0	501.82	4.4
	MEMdiff + DISdiff + group + MEMdiff * DISdiff + DISdiff * group	0.053	0.1	1.7	450.5	3.9
	MEMdiff + DISdiff	0.053	0.05	0.9	242.0	7.0
	MEMdiff + DISdiff + group + MEMdiff * DISdiff + MEMdiff * group + DISdiff * group + MEMdiff * DISdiff * group	0.053	0.04	0.7	203.5	4.9
	MEMdiff + DISdiff + group	0.053	0.02	0.4	123.2	2.9
	MEMdiff + DISdiff + group + MEMdiff * group	0.053	0.02	0.4	112.1	3.3
	DISdiff + group + DISdiff * group	0.053	0.01	0.23	72.4	2.8
	MEMdiff + DISdiff + MEMdiff * DISdiff	0.053	0.01	0.2	67.6	3.1
	MEMdiff + DISdiff + group + MEMdiff * DISdiff	0.053	0.001	0.1	36.8	3.4
	MEMdiff + DISdiff + group + MEMdiff * DISdiff + MEMdiff * group	0.053	0.01	0.1	33.2	3.9
	DISdiff	0.053	0.003	0.1	15.7	0.9
	MEMdiff	0.053	0.002	0.03	9.3	1.0
	DISdiff + group	0.053	0.002	0.03	8.1	2.5
	MEMdiff + group	0.053	9.7e -4	0.02	5.0	2.5
	MEMdiff + group + MEMdiff * group	0.053	7.9e -4	0.01	4.0	3.0
	group	0.5e-1	9.7e -5	0.002	0.5	2.2

Sup. Table S19a - Bayesian ANOVA results for results on RT, non-musicians & musicians, MEMAT-1, Memory Task only (factors: group, MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT-1 non-musicians and musicians	RT	group	0.263	0.03	0.5
		MEMdiff	0.263	0.4	19.6
		DISdiff	0.263	0.1	25.3
		group * MEMdiff	0.263	0.5	1.1
		group * DISdiff	0.263	0.8	13.6
		MEMdiff * DISdiff	0.263	0.2	0.3
		group * MEMdiff * DISdiff	0.053	0.04	0.4

Sup. Table S19b - Analysis of effects for results on RT, non-musicians & musicians, MEMAT-1, Memory Task only (factors: group, MEMdiff, DISdiff).

ANOVA on RT – non-musicians and musicians, MEMAT-1, Perception task only, with group, PERdiff and DISdiff as factors

PERCEPTION		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT-1 non-musicians and musicians	RT	Null model (incl. subject)	0.053	0.007	0.1	1.0	X
		DISdiff + group + DISdiff * group	0.053	0.5	16.5	73.5	11.3
		DISdiff	0.053	0.1	3.1	22.6	1.5
		DISdiff + group	0.053	0.1	2.1	15.8	2.6
		PERdiff + DISdiff + group + DISdiff * group	0.053	0.1	2.0	15.7	12.4
		PERdiff + DISdiff + group + PERdiff * group + DISdiff * group	0.053	0.04	0.7	5.5	4.1
		PERdiff + DISdiff + group + PERdiff * DISdiff + DISdiff * group	0.053	0.03	0.6	4.6	4.7
		PERdiff + DISdiff	0.053	0.03	0.5	4.5	2.9
		PERdiff + DISdiff + group	0.053	0.02	0.4	3.5	6.3
		PERdiff + DISdiff + group + PERdiff * DISdiff + PERdiff * group + DISdiff * group	0.053	0.01	0.2	1.7	4.1
		PERdiff + DISdiff + PERdiff * DISdiff	0.053	0.01	0.2	1.3	2.0
		PERdiff + DISdiff + group + PERdiff * group	0.053	0.01	0.1	1.2	2.8
		PERdiff + DISdiff + group + PERdiff * DISdiff	0.053	0.01	0.1	1.0	4.6
		group	0.053	0.01	0.1	0.7	2.7
		PERdiff + DISdiff + group + PERdiff * DISdiff + PERdiff * group + DISdiff * group + PERdiff * DISdiff * group	0.053	0.003	0.1	0.5	4.1
		PERdiff + DISdiff + group + PERdiff * DISdiff + PERdiff * group	0.053	0.003	0.04	0.4	4.5
		PERdiff	0.053	0.001	0.02	0.2	0.9
		PERdiff + group	0.053	8.9e -4	0.02	0.1	2.1
		PERdiff + group + PERdiff * group	0.5e-1	3.5e -4	0.01	0.1	4.5

Sup. Table S20a - Bayesian ANOVA results for results on RT, non-musicians & musicians, MEMAT-1, Perception Task only (factors: group, PERdiff, DISdiff).

PERCEPTION		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT-1 non-musicians and musicians	RT	group	0.263	0.1	0.7
		<i>PERdiff</i>	0.263	0.1	0.2
		DISdiff	0.263	0.3	21.9
		group * <i>PERdiff</i>	0.263	0.6	0.4
		group * DISdiff	0.263	0.6	4.3
		<i>PERdiff</i> * <i>DISdiff</i>	0.263	0.1	0.3
		<i>group</i> * <i>PERdiff</i> * <i>DISdiff</i>	0.053	4e -3	0.3

Sup. Table S20b - Analysis of effects for results on RT, non-musicians & musicians, MEMAT-1, Perception Task only (factors: group, *PERdiff*, *DISdiff*).

IV. MEMAT-2, non-musicians

d'

ANOVA on d' - non-musicians, MEMAT-2, Memory task, with MEMdiff and DISdiff as factors (3 levels of DISdiff: noDIS, easyDIS, hardDIS)

MEMORY		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 2 non-musicians	d'	Null model (incl. subject)	0.200	4.5e -12	1.8e -11	1.0	X
		MEMdiff	0.200	4.9e -8	1.9e -7	10743.2	0.7
		DISdiff	0.200	2.2e -7	9.0e -7	50107.6	8.5
		MEMdiff + DISdiff	0.200	0.8	15.0	1.8e +11	1.3
		MEMdiff + DISdiff + MEMdiff * DISdiff	0.200	0.2	1.1	4.7e +10	2.4

Sup.Table S21a - Bayesian ANOVA results on d' , non-musicians, MEMAT-2, Memory Task only (factors: MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 2 non-musicians	d'	MEMdiff	0.400	0.8	3.5e +6
		DISdiff	0.400	0.8	1.6e +7
		<i>MEMdiff * DISdiff</i>	<i>0.200</i>	<i>0.2</i>	<i>0.3</i>

Sup.Table S21b - Analysis of effects for results on d' , non-musicians, MEMAT-2, Memory Task only (factors: MEMdiff, DISdiff).

Criterion

ANOVA on c – non-musicians, MEMAT-2, Memory task, with task, MEMdiff and DISdiff as factors (3 levels of DISdiff: noDIS, easyDIS, hardDIS)

MEMORY		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 2 non-musicians	c	Null model (incl. subject)	0.200	0.5e-2	2.1e-2	1.0	X
		MEMdiff	0.200	0.7	10.0	135.3	1.3
		DISdiff	0.200	0.1e-2	0.5e-2	0.2	0.6
		MEMdiff + DISdiff	0.200	0.2	1.1	39.7	3.5
		MEMdiff + DISdiff + MEMdiff * DISdiff	0.200	0.1	0.3	13.3	1.7

Sup. Table S22a - Bayesian ANOVA results on c, non-musicians, MEMAT-2, Memory Task only (factors: MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 2 non-musicians	c	MEMdiff	0.400	0.9	140.7
		<i>DISdiff</i>	<i>0.400</i>	<i>0.2</i>	<i>0.3</i>
		<i>MEMdiff * DISdiff</i>	<i>0.200</i>	<i>0.1</i>	<i>0.3</i>

Sup. Table S22b - Analysis of effects for results on c, non-musicians, MEMAT-2, Memory Task only (factors: MEMdiff, DISdiff).

RT

ANOVA on RT – non-musicians, MEMAT-2, Memory task, with task, MEMdiff and DISdiff as factors (3 levels of DISdiff: noDIS, easyDIS, hardDIS)

MEMORY		Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT 2 non-musicians	RT	Null model (incl. subject)	0.200	1.9e-2	0.1	1.0	X
		MEMdiff	0.200	0.4e-2	1.7e-2	0.2	1.7
		DISdiff	0.200	0.8	13.7	40.0	1.7
		MEMdiff + DISdiff	0.200	0.2	0.8	8.4	1.6
		MEMdiff + DISdiff + MEMdiff * DISdiff	0.200	4.1e-2	0.2	2.1	2.4

Sup.Table S23a - Bayesian ANOVA results on RT, non-musicians, MEMAT-2, Memory Task only (factors: MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT 2 non-musicians	RT	<i>MEMdiff</i>	<i>0.400</i>	<i>0.2</i>	<i>0.2</i>
		DISdiff	0.400	0.9	39.6
		<i>MEMdiff * DISdiff</i>	<i>0.200</i>	<i>4.1e-2</i>	<i>0.3</i>

Sup.Table S23b - Analysis of effects for results on RT, non-musicians, MEMAT-2, Memory Task only (factors: MEMdiff, DISdiff).

V. Comparison between MEMAT-1 and MEMAT-2, non-musicians

d'

ANOVA on d' – non-musicians, MEMAT-1 and MEMAT-2, Memory task only, with EXP (experiment), MEMdiff and DISdiff as factors

MEMORY	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT-1 & MEMAT-2 non-musicians	Null model (incl. subject)	0.053	6.6e - 11	1.2e -9	1.0	X
	EXP	0.053	1.3e-11	2.3e -10	0.2	2.9
	MEMdiff	0.053	7.5e-5	0.1e-2	1.1e+6	3.1
	EXP + MEMdiff	0.053	1.4e-5	2.4e -4	204544.4	2.2
	EXP + MEMdiff + EXP * MEMdiff	0.053	3.8e -6	6.9e -5	57848.0	3.1
	DISdiff	0.053	2.2e -8	4.0e -7	332.2	0.9
	EXP + DISdiff	0.053	4.3e-9	7.7e -8	64.0	2.5
	MEMdiff + DISdiff	0.053	0.3	9.0	5.0e+9	4.5
	EXP + MEMdiff + DISdiff	0.053	0.1	1.1	8.8e+8	2.1
	EXP + MEMdiff + EXP * MEMdiff + DISdiff	0.053	1.9e-1	0.4	2.9e+8	5.7
	EXP + DISdiff + EXP * DISdiff	0.053	1.2e -9	2.1e -8	17.7	2.8
	EXP + MEMdiff + DISdiff + EXP * DISdiff	0.053	2.1e-2	0.4	3.2e+8	15.2
	EXP + MEMdiff + EXP * MEMdiff + DISdiff + EXP * DISdiff	0.053	0.5e-2	0.1	7.5e+7	2.4
	MEMdiff + DISdiff + MEMdiff * DISdiff	0.053	0.4	13.4	6.4e+9	2.4
	EXP + MEMdiff + DISdiff + MEMdiff * DISdiff	0.053	0.1	1.6	1.2e+9	2.8
	EXP + MEMdiff + EXP * MEMdiff + DISdiff + MEMdiff * DISdiff	0.053	2.3e-2	0.4	3.5e+8	3.0
	EXP + MEMdiff + DISdiff + EXP * DISdiff+MEMdiff * DISdiff	0.053	2.3e-2	0.4	3.4e+8	2.9
	EXP + MEMdiff + EXP * MEMdiff + DISdiff + EXP * DISdiff + MEMdiff * DISdiff	0.053	0.7e-2	0.1	10.0e+7	5.3
EXP + MEMdiff+ EXP * MEMdiff + DISdiff + EXP * DISdiff + MEMdiff * DISdiff + EXP * MEMdiff * DISdiff	0.053	0.3e-2	4.7e-2	3.9e+7	5.7	

Sup.Table S24a - Bayesian ANOVA results for results on d', non-musicians, MEMAT-1 & MEMAT-2, Memory Task only (factors: EXP, MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT-1 & MEMAT-2 non-musicians	d'	<i>EXP</i>	0.263	0.1	0.2
		MEMdiff	0.263	0.4	1.5e +7
		DISdiff	0.263	0.4	4442.8
		<i>EXP * MEMdiff</i>	0.263	0.1	0.3
		<i>EXP * DISdiff</i>	0.263	0.1	0.3
		MEMdiff * DISdiff	0.263	0.6	1.3
		EXP * MEMdiff * DISdiff	0.053	0.3e-2	0.4

Sup.Table S24b - Analysis of effects for results on d', non-musicians, MEMAT-1 & MEMAT-2, Memory Task only (factors: EXP, MEMdiff, DISdiff).

RT

ANOVA on RT – non-musicians, MEMAT-1 and MEMAT-2, Memory task only, with EXP (experiment), MEMdiff and DISdiff as factors

MEMORY	Models	P(M)	P(M data)	BF _M	BF ₁₀	error %
MEMAT-1 & MEMAT-2 non-musicians	Null model (incl. subject)	0.053	1.4e-4	0.3e-2	1.0	X
	EXP	0.053	8.0e-4	1.4e-2	5.6	0.9
	MEMdiff	0.053	8.5e-5	0.2e-2	0.6	1.1
	EXP + MEMdiff	0.053	5.3e-4	1.0e-2	3.7	4.8
	EXP + MEMdiff + EXP * MEMdiff	0.053	2.0e-4	0.4e-2	1.4	2.8
	DISdiff	0.053	3.4e-2	0.6	238.2	1.8
	EXP + DISdiff	0.053	0.3	7.9	2139.2	3.0
	MEMdiff + DISdiff	0.053	2.4e-2	0.4	164.8	2.4
	EXP + MEMdiff + DISdiff	0.053	0.2	5.3	1598.1	2.2
	EXP + MEMdiff + EXP * MEMdiff + DISdiff	0.053	0.1	1.9	654.6	3.2
	EXP + DISdiff + EXP * DISdiff	0.053	0.1	1.9	659.5	9.2
	EXP + MEMdiff + DISdiff + EXP * DISdiff	0.053	0.1	1.4	500.9	2.9
	EXP + MEMdiff + DISdiff + EXP * MEMdiff + DISdiff	0.053	2.6e-2	0.5	182.2	3.4
	MEMdiff + DISdiff + MEMdiff * DISdiff	0.053	0.6e-2	0.1	43.3	3.1
	EXP + MEMdiff + DISdiff + MEMdiff * DISdiff	0.053	0.1	1.2	422.4	6.4
	EXP + MEMdiff + EXP * MEMdiff + DISdiff + MEMdiff * DISdiff	0.053	2.7e-2	0.5	190.9	3.5
	EXP + MEMdiff + DISdiff + EXP * DISdiff + MEMdiff * DISdiff	0.053	1.7e-2	0.3	115.5	3.6
	EXP + MEMdiff + EXP * MEMdiff + DISdiff + EXP * DISdiff + MEMdiff * DISdiff	0.053	0.7e-2	0.1	51.3	4.5
EXP + MEMdiff + EXP * MEMdiff + DISdiff + EXP * DISdiff + MEMdiff * DISdiff + EXP * MEMdiff * DISdiff	0.053	0.3e-2	4.8e-2	18.4	4.6	

Sup. Table S25a - Bayesian ANOVA results for results on RT, non-musicians, MEMAT-1 & MEMAT-2, Memory Task only (factors: EXP, MEMdiff, DISdiff).

MEMORY		Effects	P(incl)	P(incl data)	BF _{Inclusion}
MEMAT-1 & MEMAT-2 non-musicians	RT	EXP	0.263	0.6	9.3
		MEMdiff	0.263	0.3	0.7
		DISdiff	0.263	0.7	389.5
		EXP * MEMdiff	0.263	0.2	0.4
		<i>EXP * DISdiff</i>	<i>0.263</i>	<i>0.2</i>	<i>0.3</i>
		<i>MEMdiff * DISdiff</i>	<i>0.263</i>	<i>0.1</i>	<i>0.3</i>
		EXP * MEMdiff * DISdiff	0.053	0.3e-2	0.4

Sup.Table S25b - Analysis of effects for results on RT, non-musicians, MEMAT-1 & MEMAT-2, Memory Task only (factors: EXP, MEMdiff, DISdiff).