Supplementary Material

Increasing music preference through guided self-framing: A comparison of historical and imaginative approaches

Psychology of Aesthetics, Creativity, and the Arts

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Section A – Framing instructions for the historical condition

All 53 participants in the historical condition received the same type of historical self-framing for all five stimuli. The historical framing consisted of two parts:

1) A vignette for each piece, and
2) instructions for the 'five minute task'.

After participants were seated in the testing room, the instructor gave a brief introduction explaining that for each piece two sets of text would be provided to each participant, and also explained the visual layout of the online survey and answered any queries relating to this. Participants performed the described five minute task while listening to the music, and also for the five minutes following each stimulus.

Before each piece was played, the vignette was displayed on a large screen that all participants in the class could see, and was read out by the instructor. The vignette remained onscreen during listening to the music, and also for the five minute task that followed each piece (see *Framing details* section, within the primary document). The instructions for the five minute task were displayed on the screen of each participant's device, above the survey response questions. These instructions were visible from the same time that participants could read the vignette. Vignettes and instructions are listed below.

N.B. as per the *Self-framing* section within the primary document, this condition could be considered as historical guided self-framing, as the researchers are to some extent guiding the historical framing by indicating the general approach to be taken. Regardless, the authors considered this an appropriate and novel self-framing condition for comparison with imaginative self-framing (for which there is no guided aspect).

Vignettes

Red ribbon (Low information, Pop/Rock)

This piece is called *Red ribbon*. This piece of music was released in 2010 by a Sydney-based Duo called *Bright Young Things*. Since this release, the duo has expanded to include several other instruments such as guitar, bass and live percussion. Vocalist and pianist Andrew James lists his primary influences as Freddie Mercury, Billie Joel, and Elton John.

Happy (High information, Pop/Rock)

Happy was released in November 2013 as the lead single from Pharrell Williams' album *Girl*. Additionally, the piece was part of the soundtrack for the film *Despicable Me 2*. Since its release more than 12 million copies have been sold worldwide, and it has become the most downloaded song in the United Kingdom to date. In June 2013 Williams became the 12th Billboard artist to simultaneously hold the number 1 and 2 chart positions with the songs *Blurred Lines* and *Get Lucky*.

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Megalon (Low information, Pop/Rock)
Godswounds are an Australian band who describe themselves as "experimental electronic music fused with elements of Nintendo". The band is comprised of vocals, synthesiser, trumpet, guitar, bass, and two percussionists. This track is taken off their debut album *Death to the babyboomers*.

Tallawarra (Low information, Classical)
Tallawarra, which is an Aboriginal word meaning "slippery place", was composed by John Peterson in 2000. The piece was composed for a string quartet, which consists of two violins, a viola and a cello, and was commissioned by Music Viva as part of the Australian Miniatures Project. Peterson is a well-known Australian composer who studied under Peter Sculthorpe and Ross Edwards, and is a member of academic staff in music at the University of New South Wales.

Etwas bewegte (High information, Classical)
This excerpt is from *Six Pieces for Large Orchestra, Opus 6,* composed by Anton Webern in 1928. This is a revolutionary work of the mid twentieth century, demonstrating a radical, new, innovative way of composing. This composition rejects overly gratuitous musical writing and allows the music to be simply "sounds". The focus of the compositional style is to produce colours with the orchestra, rather than the conventional melodies and harmonies that were expected in most Western music up until the twentieth century, and in nearly all popular music. When people listen to this piece as "sound colors" they tend to appreciate the music more. This excerpt consists of the first two movements of the larger work.

Five minute task instructions (historical condition)
Each time you listen to a piece from the playlist, in the task response box write down some background information about the piece, performers and/or composer/arrangers – either what you already know, or what you have recently found out. Feel free to do some research about the piece, however you want to.

Section B – Framing instructions for the imaginative condition

All 50 participants in the imaginative condition received the same type of imaginative self-framing for all five stimuli. After participants were seated in the testing room, the instructor gave a brief introduction explaining that text would be provided to each participant before listening for each piece, explained the visual layout of the online survey, and answered any queries relating to this. The framing consisted of only one set of instructions (listed below), which were displayed both on a large screen that all participants in the class could see as well as on each participant's device. The instructor read out the instructions before each piece was played, although these instructions were identical for each piece. Participants performed the described task while listening to the music, and also for the five minutes following each stimulus.

Imaginative condition instructions

Each time you listen to a piece from the playlist, in the task response box write an invented, imagined story that the music evokes. That is, try to invent/develop a story/scenes that could go with this music. Write down the story/scenes you are imagining when listening to this music, whether they are ones you recollect from previous listenings to the same piece, new ones, or a mixture of new and old. The story/scenes can be completely made up, or based on something real, or a set of unrelated scenes. They can be abstract, whacky, non-representational, representational or anything at all that comes to mind. There are no rules, but you should try to link the thoughts and images to the music as much as possible. You can make references to different parts of the musical excerpt, or just write about the images as they come to you, without explicitly referring to the music.

Some ideas you could consider:

1) Imagine a series of images/slides that are presented as a backdrop to a live performance of the piece - What images would you choose? List them in the sequence of the music (for example, one line describing each projected image in the sequence).

2) Imagine the music is accompanying a scene from a short film - what is the story?

Section C – Framing instructions for the unrelated condition

All 49 participants in the unrelated condition received the same type of unrelated self-framing for all five stimuli. After participants were seated in the testing room, the instructor gave a brief introduction explaining that text would be provided to each participant before listening for each piece, explained the visual layout of the online survey, and answered any queries relating to this. The framing consisted of only one set of instructions (listed below), which were displayed both on a large screen that all participants in the class could see as well as on each participant's device. The instructor read out the instructions before each piece was played, although these instructions were identical for each piece. Participants performed the described task while listening to the music, and also for the five minutes following each stimulus.

Unrelated condition instructions

Each time you listen to a piece from the playlist, play one of the following online games while the music is playing. Please make sure the **sound is off** so that you can hear the music from the playlist in the background. You can continue this game for the five minutes following the music.

1. MEMORY (also known as concentration): [http://www.mathsisfun.com/games/memory/]
2. ONLINE JIGSAW: [http://www.jigsawplanet.com/]
3. WORDSHAKE: [http://learnenglishkids.britishcouncil.org/en/fun-games/wordshake]
4. 7 LETTERS: [http://www.ecenglish.com/learnenglish/seven-letters-game]
5. BOGGLE: [http://www.wordplays.com/boggle]

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Section D – Condition distribution, descriptive statistics of preference, and supplementary Bayesian analysis data

Supplementary Table 1

Distribution of participants across the three conditions, first collapsed across between-subject variables, and then split by gender and musicianship categories.

Categorization	Historical condition	Imaginative condition	Unrelated condition
All participants	53	50	49
Females	32	34	23
Males	21	16	26
Other/prefer not to say	0	0	0
Untrained	21	30	26
Trained	32	20	23

Supplementary Table 2

Summary of the framing vignettes and five minute tasks for each condition. Regardless of condition, participants responded to the same four variables (preference, complexity, familiarity, unusualness).

Condition	**Vignette**	**Five minute task**
Historical	Participants provided with identifying historical information	Participants asked to search online for any information about the music, artist, and so on. They could perform this task while listening and also during the following five minutes
Imaginative	No identifying information provided. Participants encouraged to freely imagine while listening	Participants were able to continue free imagination for the five minutes following listening
Unrelated	No identifying information provided. Participants asked to select an online game from a list, and to play it while listening	Participants were able to continue with their selected game for the five minutes following listening

Note. The four variables could be responded to at any point after the music began, in any order, and could be changed at any point up until the end of the five minute task. The High information/Low information split between stimuli can be seen to impact the historical condition only, as the other conditions did not engage with any historical framing.

Supplementary Table 3

Descriptive statistics of preference (scale of 0 to 10), reported as M (SD). These are reported for each piece, and are also split by condition, musicianship, and gender.

Category	*Red ribbon*	*Tallawarra*	*Megalon*	*Happy*	*Etwas bewegte*	All pieces
Historical	4.9 (2.7)	7.6 (1.6)	3.6 (2.6)	7.8 (2.0)	4.8 (2.5)	5.7 (2.8)
Imaginative	6.1 (2.7)	6.9 (2.2)	2.9 (2.5)	7.7 (2.2)	4.3 (2.7)	5.6 (3.0)
Unrelated	3.3 (3.1)	6.9 (2.4)	5.2 (3.3)	6.5 (3.0)	3.5 (3.2)	5.1 (3.3)
Untrained	4.6 (3.1)	6.6 (2.2)	3.6 (3.0)	7.0 (2.8)	3.6 (2.9)	5.1 (3.2)
Trained	5.0 (3.0)	7.6 (1.9)	4.1 (2.9)	7.6 (2.2)	4.8 (2.7)	5.8 (2.9)
Females	4.8 (3.0)	7.3 (2.0)	3.5 (3.0)	7.6 (2.5)	3.9 (2.5)	5.4 (3.1)
Males	4.7 (3.1)	6.9 (2.1)	4.3 (2.8)	7.0 (2.5)	4.6 (3.2)	5.5 (3.0)

Note. The "All conditions" row refers to data collapsed across the three conditions; this produces the same values as when collapsed across both musicianship categories or both gender categories, and so these rows are not shown.

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Supplementary Table 4

Evidence ratios and posterior probabilities for Model 1. First, these are shown for the three contrasts between the three framing conditions, collapsed across all pieces. Second, this is shown for the three framing conditions, separately for each of the five pieces.

Hypothesis	Estimate	Estimate error	C.I. lower	C.I. upper	Evidence ratio	Posterior probability	Star
All pieces collapsed:							
(I – U) > 0	0.44	0.94	- 1.09	1.93	2.32	0.70	
(H – U) > 0	0.62	0.66	- 0.44	1.64	5.71	0.85	
(H – I) < 0	- 0.18	0.82	- 1.47	1.11	1.58	0.61	
Hypothesis by piece	**Estimate**	**Estimate error**	**C.I. lower**	**C.I. upper**	**Evidence ratio**	**Post. prob.**	**Star**
Red ribbon:							
(I – U) > 0	2.56	0.52	1.71	3.40	>7999.00	1.00	*
(H – U) > 0	1.50	0.49	0.71	2.30	887.89	1.00	*
(H – I) > 0	1.06	0.50	0.24	1.88	58.26	0.98	*
Happy:							
(I – U) > 0	1.15	0.51	0.32	1.99	77.43	0.99	*
(H – U) > 0	1.22	0.47	0.44	2.00	249.00	1.00	*
(H – I) < 0	- 0.06	0.48	- 0.86	0.71	1.21	0.55	
Megalon:							
(I – U) < 0	- 1.97	0.53	- 2.83	- 1.09	7999.00	1.00	*
(H – U) < 0	- 1.06	0.53	- 1.92	- 0.19	43.20	0.98	*
(H – I) < 0	- 0.91	0.51	- 1.75	- 0.05	22.67	0.96	*
Tallawarra:							
(I – U) > 0	0.17	0.51	- 0.67	0.99	1.74	0.63	
(H – U) > 0	0.75	0.46	- 0.01	1.51	18.00	0.95	†
(H – I) < 0	- 0.58	0.47	- 1.36	0.20	8.15	0.89	
Etwas bewegte:							
(I – U) > 0	0.51	0.51	- 0.35	1.35	5.19	0.84	
(H – U) > 0	0.87	0.49	0.07	1.69	27.88	0.97	*
(H – I) < 0	- 0.36	0.49	- 1.17	0.43	3.28	0.77	

Note. Estimate is the posterior mean of the effect size, C.I. Lower and C.I. Upper give its 90% credibility intervals. Evidence ratio and Posterior probability quantify evidence in favor of the hypothesis in the first column; note that Evidence Ratio = Posterior probability / (1 – Posterior probability). Evidence ratios greater than 19 (equivalently, posterior probabilities greater than 0.95) are starred, whereas moderate to strong evidence ratios (16-19) are denoted with †.

Supplementary Table 5

For Model 1, residual correlations between ratings of preference, familiarity, unusualness, and complexity.

Hypothesis	Estimate	Estimate error	C.I. lower	C.I. upper	Evidence ratio	Posterior probability	Star
Preference, Familiarity > 0	0.24	0.04	0.17	0.30	>7999.00	1.00	*
Preference, Unusualness < 0	- 0.07	0.04	- 0.13	0.00	20.33	0.95	*
Familiarity, Unusualness < 0	- 0.14	0.04	- 0.21	- 0.08	7999.00	1.00	*
Preference, Complexity > 0	0.07	0.04	0.01	0.14	35.20	0.97	*
Familiarity, Complexity < 0	- 0.03	0.04	- 0.10	0.03	3.99	0.80	
Unusualness, Complexity > 0	0.31	0.04	0.26	0.37	>7999.00	1.00	*

Supplementary Table 6

For Model 1, leave-one-out cross-validated R^2 (LOO-R2) values for the four types of rating: preference, familiarity, complexity, and unusualness. The calculation for LOO-R2 is similar to the standard R-squared (1 – SSE/SST) except the errors are for every left-out-observation in the leave-one-out cross-validation. In this way, LOO-R2 acts like an adjusted R-squared by penalizing any overfitting.

Variable	Estimated R^2	Estimate error
Preference	0.28	0.03
Familiarity	0.56	0.02
Complexity	0.24	0.03
Unusualness	0.27	0.03

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Supplementary Table 7

Evidence ratios and posterior probabilities for Model 2. By row, the hypothesis tests are for the effect of Information, and for the effects of Genre in each of the three framing conditions.

Hypothesis	Estimate	Estimate error	C.I. lower	C.I. upper	Evidence ratio	Posterior probability	Star
Information: High – Low > 0	0.76	0.39	0.10	1.42	35.14	0.97	*
Genre: Classical – Pop/Rock; Condition: U > 0	0.23	0.38	- 0.39	0.86	2.69	0.73	
Genre: Classical – Pop/Rock; Condition: I > 0	0.05	0.38	- 0.57	0.67	1.24	0.55	
Genre: Classical – Pop/Rock; Condition: H > 0	0.59	0.38	- 0.03	1.21	15.55	0.94	

Note. See Supplementary Table 4 for description of columns.

Supplementary Table 8

PSIS-LOO cross-validation values between Model 1 and expanded versions where musicianship, gender, or both were added.

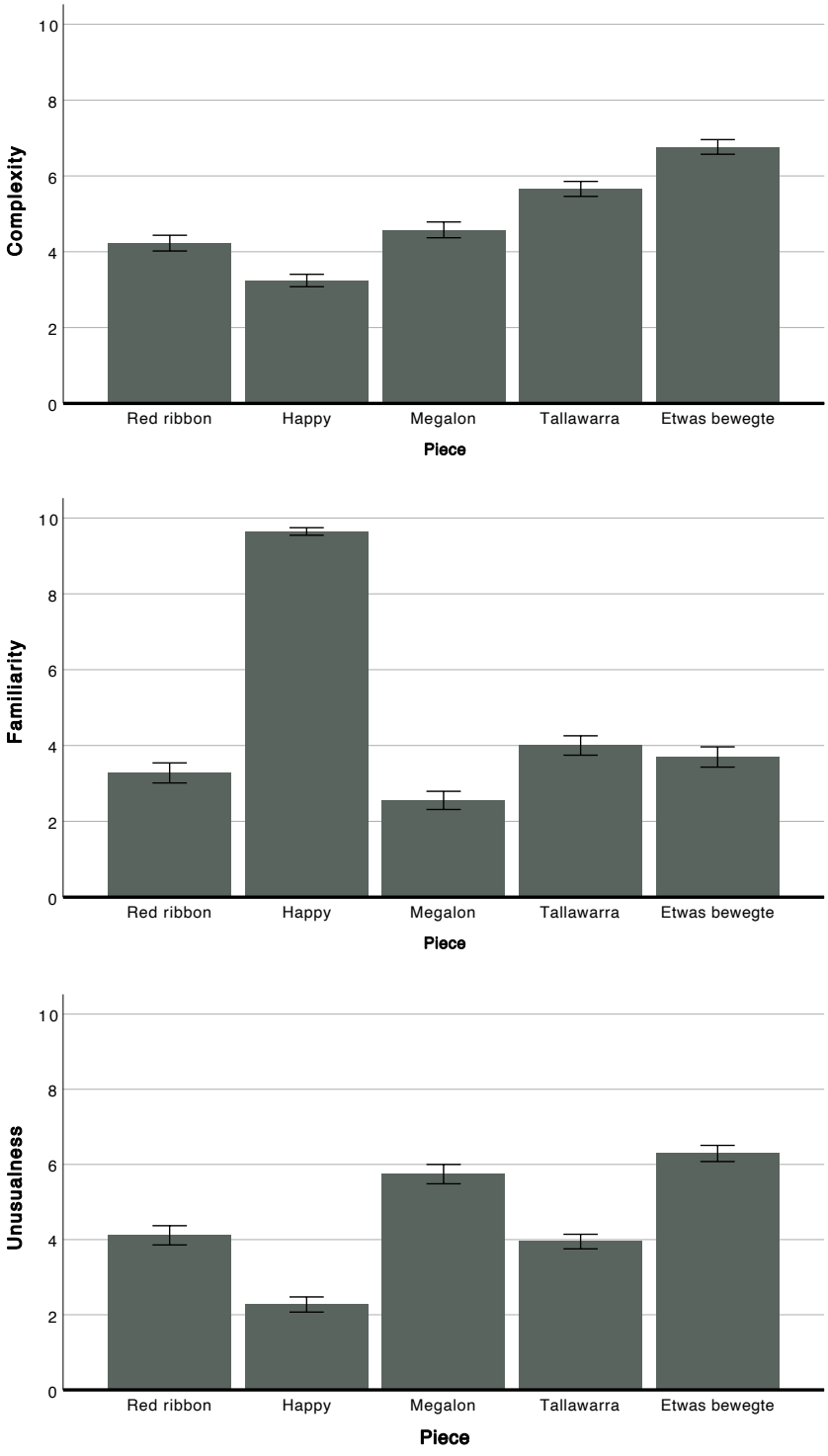
Model	ELPD difference	Standard Error difference
Condition	0.0	0.0
Condition, Gender	-9.5	4.4
Condition, Musicianship	-10.9	5.1
Condition, Gender, Musicianship	-18.5	6.7

Supplementary Table 9

PSIS-LOO cross-validation values between Model 2 and reduced versions where information, genre, or both have been removed.

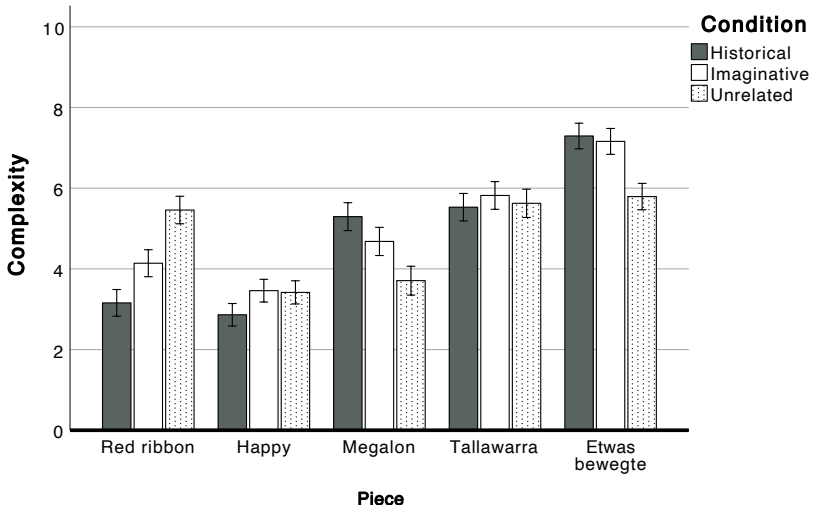
Model	ELPD difference	Standard Error difference
Condition, Information, Genre	0.0	0.0
Condition, Genre	-52.9	10.0
Condition, Information	-92.7	13.1
Condition	-139.6	17.0

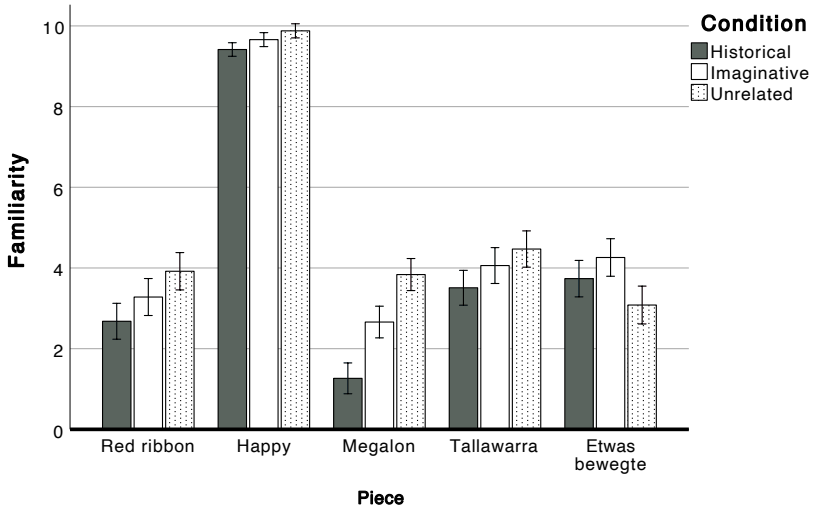
Section E – Data for collative variables

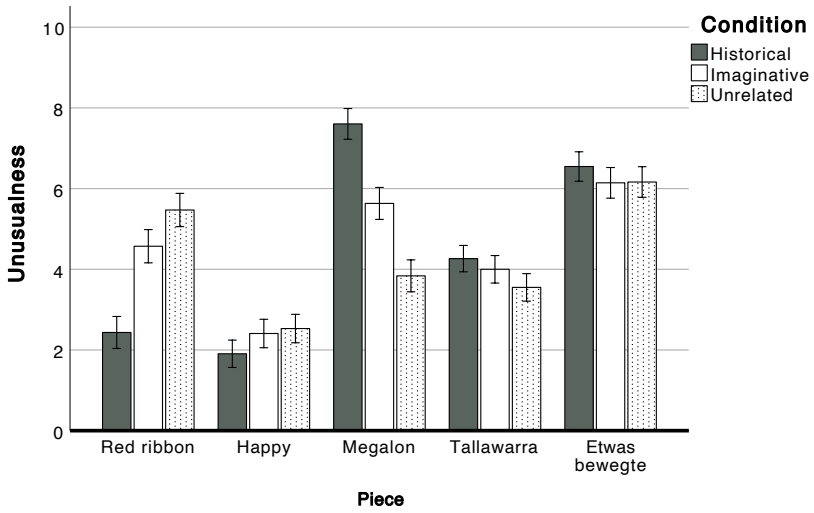


Supplementary Figure 1

Plotted means of the three collative variables (complexity, familiarity, and unusualness), split by piece. These variables were gathered to ensure that a varied stimulus selection was achieved. Error bars = ± 1 SE.







Supplementary Figure 2

Plotted means of the three collative variables (complexity, familiarity, and unusualness), split by piece and also by condition. The pieces Red ribbon and Megalon contained the largest differences between conditions, and received at least one significant difference between conditions for each piece. Error bars = ± 1 SE.

Section F – Syntax for *R*

In this section we provide the syntax that was used in *R* (version 4.1.2) to run the Bayesian models.

Model 1: Condition by Piece

```
mdl_cond <-
 brm(
  mvbind(Preference, Familiarity, Unusualness, Complexity) ~
    Condition +
    (Condition | Piece) +
    (1 | Participant),
  data = data,
  family = gaussian(),
  prior = set_prior("normal(0, 3)", class = "b"),
  sample_prior = "yes",
  iter = 4000,
  control = list(adapt_delta = 0.99),
  )
mdl_cond

mdl_cond <-
 add_criterion(
  mdl_cond,
  c("loo", "bayes_R2", "loo_R2"),
  reloo = TRUE)

bayes_R2(mdl_cond)
loo_R2(mdl_cond)
```

Model 1 continuation: Condition by Piece, with Musicianship added

```
mdl_cond_mus <-
 brm(
  mvbind(Preference, Familiarity, Unusualness, Complexity) ~
       Condition * Musicianship +
       (Condition * Musicianship | Piece) +
       (1 | Participant),
  data = data,
  family = gaussian(),
  prior = set_prior("normal(0, 3)", class = "b"),
  sample_prior = "yes",
  iter = 4000,
  control = list(adapt_delta = 0.99, max_treedepth = 12),
  )
mdl_cond_mus

mdl_cond_mus <-
 add_criterion(
  mdl_cond_mus,
  "loo",
  reloo = TRUE)
```

Model 1 continuation: Condition by Piece, with Gender added (Musicianship removed)

```
mdl_cond_gen <-
 brm(
  mvbind(Preference, Familiarity, Unusualness, Complexity) ~
   Condition * Gender +
   (Condition * Gender | Piece) +
   (1 | Participant),
  data = data,
  family = gaussian(),
  prior = set_prior("normal(0, 3)", class = "b"),
  sample_prior = "yes",
  iter = 4000,
  control = list(adapt_delta = 0.99),
  )
mdl_cond_gen

mdl_cond_gen <-
 add_criterion(
  mdl_cond_gen,
  "loo",
  reloo = TRUE)
```

Model 1 continuation: Condition by Piece, with both Musicianship and Gender added

```
mdl_cond_mus_gen <-
 brm(
  mvbind(Preference, Familiarity, Unusualness, Complexity) ~
   Condition * (Musicianship + Gender) +
   (Condition * (Musicianship + Gender) | Piece) +
   (1 | Participant),
  data = data,
  family = gaussian(),
  prior = set_prior("normal(0, 3)", class = "b"),
  sample_prior = "yes",
  iter = 4000,
  control = list(adapt_delta = 0.99),
  )
mdl_cond_mus_gen

mdl_cond_mus_gen <-
 add_criterion(
  mdl_cond_mus_gen,
  "loo",
  reloo = TRUE)
```

Model 1 PSIS-LOO comparison

```
loo_compare(
 mdl_cond,
 mdl_cond_mus,
 mdl_cond_gen,
 mdl_cond_mus_gen
)
```

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Model 2 (examining H4)

```
mdl_cond_inf_genre <-
 brm(
   mvbind(Preference, Familiarity, Unusualness, Complexity) ~
     Condition * Genre + Historical:Information +
     (Genre + Historical:Information | Participant),
   data = data,
   family = gaussian(),
   prior = set_prior("normal(0, 3)", class = "b"),
   sample_prior = "yes",
   iter = 6000,
   )
mdl_cond_inf_genre

mdl_cond_inf_genre <-
 add_criterion(
   mdl_cond_inf_genre,
   "loo",
   reloo = TRUE,
   ndraws = 4000
 )
```