Speed Is Associated With, But Does Not Cause, Polarization in the Moral Evaluation of Real-World Images

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Research Article

Keywords: Speed, polarization, moral evaluation, real-world images, speed-accuracy tradeoff

Posted Date: December 9th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-1122225/v1

Abstract

In human perceptual decision-making, the speed-accuracy tradeoff establishes a causal link between urgency and reduced accuracy. Less is known about how urgency affects the moral evaluation of visual images. Here, we asked participants to give ratings for a diverse set of real-world images on a continuous scale from -10 (“very immoral”) to +10 (“very moral”). We used a cueing procedure to inform the participants on a trial-by-trial basis whether they could make a Self-Paced (SP) evaluation or whether they had to perform a Time-Limited (TL) evaluation within 2 seconds. In the SP condition, fast responses were associated with more extreme evaluations. Compared to the SP condition, the responses in the TL condition were much faster, indicating that our urgency manipulation was successful. However, comparing the SP versus TL conditions, we found no significant differences in the moral evaluation of the real-world images. The data indicated that, while speed is associated with polarization, urgency does not cause participants to make more extreme evaluations. Instead, the correlation between speed and polarization likely reflects the ease of processing. Images that are obviously moral or immoral are categorized faster and given more extreme evaluations than images for which the moral interpretation is uncertain.

Introduction

In the study of decision-making, the well-know speed-accuracy tradeoff is arguably one of the most fundamental phenomena[1–4]. With more time we make fewer errors. This is true not only for humans across a wide variety of task domains[5–8], but even for bees and ants[9–10]. In perception and memory tasks as well as economical choices, it has been shown that decision-makers can adapt to time pressure, but also strategically set the amount of time and effort they invest in processing information for decision-making, by weighing the cost of time versus the gain in accuracy. Thus, decision-makers can manipulate the speed-accuracy tradeoff, aiming for optimality in given circumstances[11–13].

When measuring the accuracy of performance during perceptual discrimination or memory, researchers rely on objective information that can readily be verified. Responses are true or false, whether we like it or not. However, in other domains we often make decisions or judgements based on subjective evaluations that cannot readily be measured in terms of accuracy[14–16]. One person’s judgment may be wholly different from another’s, yet neither is necessarily wrong. The discourse between tea and wine has been going on for more than a millennium[17], and according to the Latin proverb *De gustibus non est disputandum* (“In matters of taste there can be no dispute”) we are fully entitled to have our own preferences, no matter what everyone else says. Examples of subjective decision-making include those based on preference formation with respect to the perceived attractiveness of faces, foods, or works of art, to name the most commonly researched categories[18–20]. Another type of subjective decision is based on moral evaluation, which may involve intuition or reasoning, and be shaped by cultural background and personal experience, with a complexity of processing that does not afford an easy metric of accuracy[21–

[23]. For these diverse types of subjective decision-making, little is known about the relationship between speed and decision performance.

As a metric of performance in subjective decision-making, the nearest equivalent to accuracy would arguably be the consistency of response, measured across a population of decision-makers (e.g., the level of agreement or consensus) or measured across a sample of decisions for the same items under different conditions (e.g., the level of reproducibility)[14]. We may have our idiosyncratic preferences, but there should be a system in our proverbial madness. Our tastes would not be random, but follow some kind of internal logic. This logic should give reproduceable answers. Accordingly, one hypothesis here would be that the speed-accuracy tradeoff corresponds to a speed-consistency tradeoff in subjective decision-making. With more time, decision-makers would show higher consistency in their responses. One might argue that, the extra time for information processing should give decision-makers the opportunity to form more precise and more stable object representations of the items under consideration. This would lead to less variability in the evaluation (i.e., a narrower response distribution, with a smaller standard deviation) but not necessarily a change in the mean of the evaluations (i.e., with or without a lateral shift of the response distribution).

On the other hand, speeded responses might be fundamentally different from slow responses – more intuitive, more emotionally charged. Put differently, subjective decision-making might involve a shift in the nature of the underlying evaluation mechanisms as a function of the amount of time available for processing. This would imply an altered relation between speed and performance in subjective decision-making as compared to the speed-accuracy tradeoff in objective decision-making.

Notably, subjective decision-making involves a complex system with parallel and interactive streams of affective processing, including fast, intuitive emotional reactions and slow, controlled evaluations based on reasoning[21–22,24–26]. By this account, speeded subjective decisions would tend to be more polarized or extreme (highly positive or negative), driven by an emotional charge, whereas slow subjective decisions would be more moderate, controlled by deliberative reasoning that would tend to seek a middle ground or compromise among item characteristics with divergent affective values. Thus, we can raise a speed-polarization hypothesis, proposing that faster responses would lead to more extreme evaluations. Particularly, time pressure would act as a stressor that reinforces the emotional charge and biases the moral evaluation toward fast, intuitive emotional reactions[20,27–30]. Consequently, urgency would lead to polarization in the evaluation.

In our previous research on preference formation with respect to food images, we found preliminary evidence that at first glance seems to support the speed-polarization hypothesis. In self-paced viewing conditions, fast responses tended to be associated with extreme ratings (both the highest and lowest ratings), whereas slow responses tended to be associated with intermediate ratings[16,31–32]. Importantly, however, this evidence merely established a correlation between speed and polarization in the preference formation with food images.

In the present study we set out to examine the speed-polarization hypothesis with a different type of subjective decision-making: the moral evaluation of real-world images. We chose to work with moral evaluation for two reasons. First, we aimed to find converging evidence with a very different type of subjective decision for the correlation between speed and polarization. Second, moral evaluation is the type of subjective decision-making whose underlying mechanisms has been characterized in greatest detail, with solid evidence for the existence of fast, emotional processes versus slow, deliberative processes[21–22, 24,33–34]. Thus, moral evaluation was the appropriate type of decision to examine whether speed actually causes polarization.

We designed the present experimental paradigm to compare the moral evaluation of real-world images under self-paced viewing versus under time pressure (See Figure 1). We prepared a stimulus set ranging from “very moral” to “very immoral” images based on the Socio-Moral Image Database (SMID)[35]. We asked participants to rate real-world images on a continuous scale from -10 (“very immoral”) to +10 (“very moral”). To create conditions with and without urgency, we used a cueing procedure to instruct the participants at the beginning of each trial whether they could take as long as they wanted to make the evaluation (Self-Paced condition, SP; left panel of Figure 1) or whether they had to make the evaluation within 2 seconds (Time-Limited condition; TL, right panel of Figure 1). In the TL condition, the trial was aborted and an error message was given when the participant took too long to respond.

Figure 2 presents the alternative predictions from two hypotheses. According to the speed-polarization hypothesis (left panel), speed causes the moral evaluations to be more polarized, and so the ratings under time pressure in the TL condition would be more extreme (i.e., more positive ratings for moral images and more negative ratings for immoral images) than the ratings without time pressure in the SP condition. In contrast, the right panel shows an alternative, decision-difficulty hypothesis, by which there would be no differences in the mean ratings between the SP and TL conditions. According to the decision-difficulty hypothesis, speed does not cause polarization. Instead, fast responses may be correlated with extreme ratings as a function of the ease of categorization of moral images. Some images would have a very salient moral content, enabling fast categorization with an extreme rating, whereas other images would have a less salient moral content, requiring more time to categorize and tending to produce more moderate ratings. The decision-difficulty hypothesis implies a correlative relationship, but no causal relationship, between speed and polarization. (Note that the decision-difficulty and the speed-polarization hypotheses are both compatible with the notion of an additional speed-consistency tradeoff, whereby the TL responses should show more variation than the SP responses.)

Methods

Participants

Thirty-two students at Kyushu University were recruited as participants for the experiment. One participant chose to discontinue the experiment midway due to physical discomfort; another participant indicated that she had participated in a different experiment using similar images. Thus, the current

dataset consisted of data from 30 participants: 15 males and 15 females with a mean age of 22.67 years old, and a standard deviation of 1.81. The participants had no previous experience in any similar experiment. They were asked to use their right hand to manipulate the joystick during the experiment though 2 participants were left-handed. No participant reported any vision or health issue, or past or present psychological disorder. The study was approved by the Human Ethics Committee of the Faculty of Arts and Science at Kyushu University; all methods were performed in accordance with the relevant guidelines and regulations. Informed consent was obtained in writing from each participant before the experiment; the informed consent included a no-risk statement and rights protection. Each participant received 1000 yen as monetary compensation for their participation. The experiment consisted of a single session of approximately 1 hour.

Apparatus and Stimuli

The visual stimuli were presented in a normally-lit room on a 23.8-inch full high definition flat-panel-monitor, with a display resolution of 1920 × 1080 pixels. The participants were seated in front of the monitor, at a comfortable distance of their own choosing (with no head or chin restraint). The manual responses were recorded using a joystick (Logitech, Switzerland; model no. 963290-0403). All events and recordings were controlled through code written in Psychopy (version 1.90.3)[42-43].

The target visual stimuli consisted of 160 real-world images selected from the Socio-Moral Image Database (SMID)[35]. The images provided content ranging from very moral (i.e., morally acceptable) to very immoral (i.e., morally offensive), depicting war scenes, weapons, accidents, landscapes, and various types of social interaction. Based on the original categorization in the moral domain of SMID, we preselected a balanced set of moral and immoral images. For confirmation, we conducted a preparatory rating experiment with 10 students in the lab, asking them to rate the preselected images with respect to their moral content from -10 (extremely immoral) to +10 (extremely moral). We were able to select a balanced set with 80 moral images and 80 immoral images. All images were presented either in their original proportions or resized (while maintaining the aspect ratio) to fit within a 1920×1080 pixels frame. During the experiment, each target stimulus was presented against a black background together with an evaluation scale underneath the image. The stimulus was centered at the middle of the upper two-thirds of the screen; the evaluation scale was centered at the middle of the lower third of the screen.

Time-instruction cues were used to indicate on a trial-by-trial basis whether the participant should perform the moral evaluation at their own pace or within 2 s (see Figure 1). The time-instruction cues were two monochrome icons: an icon of beach landscape with a palm tree for the Self-Paced (SP) condition; an icon of a sand clock with a short low beep sound for the Time-Limited (TL) condition. The time-instruction cues were presented centered at the middle of the upper third of the screen, with their sizes fixed at 376 × 376 pixels.

Procedure

An experimental session lasted approximately 1 hour. The experimental session was divided into 4 blocks of 40 trials, with breaks between the blocks. Participants were asked to give their informed consent in writing and fill out a pre-questionnaire prior to the experiment. Before the actual data collection, participants were given detailed task instructions and presented with 20 practice trials to familiarize themselves with the time instructions and the operation of the joystick.

All trials started with a 1-s fixation screen, in which a fixation cross was centered at the middle of the top third of the display (see Figure 1). Then, a time-instruction cue was presented, centered at the same position as the fixation cross, for a period of 1.5 s, to indicate whether it was an SP trial or a TL trial. In case of a TL cue, the visual presentation was accompanied by a low beep sound to increase the sense of urgency. Following the 1.5 s presentation of the time-instruction cue, the target image was displayed together with the evaluation scale until the participant had completed their moral evaluation, or for a maximal duration of 2 s in a TL trial. Participants were asked to rate the depicted content in each image on a continuous scale from -10 (“very immoral”) to +10 (“very moral”) by bending the joystick in the corresponding direction and clicking the trigger on the joystick to mark the evaluation. The moral evaluation task was explained at the beginning of the experiment, but not shown in words during the trials; instead, only the evaluation scale was shown in each trial. In a TL trial, in case the participant missed the 2 s deadline, a high beep was presented together with the message “Time out!!” displayed in red, centered at the middle of the upper third of the screen. At the end of each trial, there was an inter-trial-interval (ITI) of between 1.6 and 2 s, with a blank screen.

An experimental session consisted of 160 trials, divided into 4 conditions, with 2 levels of time instruction (SP, TL) and 2 levels of morality of the image content (moral, immoral). No image was presented more than once. The 160 trials were presented in pseudorandom order to ensure that each block of 40 trials contained the same distribution of trials per condition. The assignment of images to SP versus TL conditions was counterbalanced across participants.

Results

The present data set included data from 30 subjects, each presented with a total of 160 trials, separated into 4 conditions with 40 trials each, corresponding to the 2 × 2 design with the factors *Time Control* (Self-Paced versus Time-Limited) and *Morality* of the image content (Moral versus Immoral). All participants completed all trials in the SP condition; on average, all participants completed 94.54% of the trials in the TL condition (standard deviation, S.D. = 4.76). In the remaining 5.46% of the TL trials, the participants failed to respond within the deadline of 2 s. No participant missed more than 20% of the TL trials. The number of completed trials provided sufficient data for the present analyses.

We focused on the evaluation scores and response times as dependent measures. The evaluation scores were defined as the ratings on a scale from -10 (“very immoral”) to +10 (“very moral”), as confirmed by the participants when clicking the trigger on the joystick. The response times were defined as the time from the onset of the target image to the click on the joystick. Considering the limitations of *p* statistics,

particularly with respect to bias against the null hypothesis, we opted to conduct Bayesian testing following the guidelines and using the JASP software package provided by Wagenmakers et al.[36-37] For comparison, we performed conventional *p* statistics, reaching the same conclusions, as can be assessed visually in the figures with the error bars, which represent the 95% confidence intervals around the means.

Overall analysis

Figure 3 presents the means and 95% confidence intervals for the evaluation scores (left panel) and for the response times (right panel) as a function of the morality of the image content and the time control condition. This analysis was based on the averaged data for each participant in each condition (N = 30). With respect to the evaluation scores, visual inspection of the data suggested that the time control factor did not influence the evaluations. For inferential statistics, we conducted a two-way Bayesian repeated-measures ANOVA using Morality of the image content (moral versus immoral) and Time Control (self-paced versus time-limited) as within-subjects factors. To be able to compare the evaluation scores for moral and immoral images in terms of their polarization (i.e., distance from zero), we inversed the sign for the data with immoral images in this analysis.

The model comparison showed that the data provided the strongest evidence in favor of the null model (with a Bayes Factor of 6.894); the next best model was one with Morality only (BF_{10} = 0.274). Table 1 presents the analysis of the effects, with $BF_{inclusion}$ values of 0.204 for Morality, 0.160 for Time Control, and 0.100 for the interaction, indicating that the variation of the data was best explained without these factors. Overall, the evaluation scores in the self-paced condition (M = 5.072; S.D. = 2.091) were not different from those in the time-limited condition (M = 4.979; S.D. = 1.993).

We also conducted a two-way Bayesian repeated-measures ANOVA based on the response times, using Morality of the image content (moral versus immoral) and Time Control (self-paced versus time-limited) as within-subjects factors. In this analysis, the best model was one with Time Control only (BF_M = 10.531), with the next best model being one that included Time Control and Morality (BF_{10} = 0.275). Table 2 presents the analysis of the effects, with a $BF_{inclusion}$ value for Time Control approaching infinity, whereas the other values were less than 0.33, indicating that the variation of the data was best explained by including the Time Control factor. Overall, the response times in the self-paced condition (M = 2.793; S.D. = 1.186) were much slower than those in the time-limited condition (M = 1.238; S.D. = 0.168), proving that our Time Control manipulation successfully induced participants to speed up their responses when given a deadline of 2 s. Importantly, despite this solid increase in response speed, the participants' average evaluation scores did not change.

Median-split analysis

In previous research on preference formation with respect to food, we observed a robust association between response speed and polarized evaluation, such that extreme evaluation scores were consistently associated with fast response times[16,31-32]. To examine whether such an association between speed and

polarization exists also for the moral evaluations in the present paradigm, we performed a median-split analysis, separating the fast responses from the slow responses for each participant in each condition. Then, we conducted a three-way Bayesian repeated-measures ANOVA based on the averaged evaluation scores for each participant (N = 30), using Morality of the image content (moral versus immoral), Time Control (self-paced versus time-limited), and Response Speed (fast versus slow) as within-subjects factors. Again, to be able to compare the evaluation scores for moral and immoral images directly, we inversed the sign for the data with immoral images.

The model comparison provided the strongest evidence in favor of a model with Response Speed only (BF_M = 10.151). Table 3 presents the analysis of the effects, with notably a $BF_{inclusion}$ value of 930864.665 for Response Speed, whereas for all other factors and interactions there was weak or no support for model inclusion. Overall, the evaluation scores for fast responses (M = 5.530; S.D. = 2.308) were more extreme than those for slow responses (M = 4.519; S.D. = 1.990), corroborating our previous observation that, within conditions, response speed is associated with polarization of the evaluation.

To examine this phenomenon in more detail, we conducted Bayesian paired *t*-tests for each of the 2 × 2 conditions separately. Figure 4 presents the averages and confidence intervals of the evaluation scores, comparing fast versus slow responses, for each of the 4 conditions, next to the results of the corresponding Bayesian paired *t*-test. The associations between response speed and evaluation polarization were solid in the self-paced conditions, with a Bayes Factor (BF_{10}) of 1219.287 for moral images and 580.959 for immoral images, but less so in the time-limited conditions.

Correlation analysis

To gain further insights into the present data patterns as a function of response speed and the time control conditions, we performed item-based analyses, computing for each image (N = 160) the average evaluation score and response time in the SP condition versus the TL condition. Figure 5 presents the scatter plot with histograms and linear regression line for the item-based correlation between evaluation scores in the SP condition versus the TL condition. The Pearson's *r* value was 0.976. Bayesian testing of the correlation produced a Bayesian Factor (BF_{10}) of 7.297e+101, indicating very strong evidence supporting a positive correlation. Thus, the moral evaluation scores for the real-world images were very similar across the SP and TL conditions.

Figure 6 presents the scatter plots with histograms and smooth regression lines (with 95% confidence interval) for the item-based correlations between the evaluation scores and the response times in the SP condition (left panel) and in the TL condition (right panel). Visual inspection of the correlations suggested parabolic trends (inverse U-shapes), with relatively fast responses for the more extreme evaluation scores, but relatively slow responses for the intermediate evaluation scores. Accordingly, Bayesian testing confirmed that neither trend produced a linear relationship: For the SP condition, the Pearson's *r* value was -0.190, with a BF_{10} of 1.742; for the TL condition, the Pearson's *r* value was 0.031, with a BF_{10} of 0.106, giving little or no evidence in favor of a correlation.

Discussion

In the present study, we set out to examine the relationship between speed and moral evaluation of real-world images. Using images ranging from “very moral” to “very immoral” taken from the Socio-Moral Image Database (SMID)[35], we asked participants to give ratings to reflect their evaluation on a continuous scale from -10 to +10, either with or without time pressure. We found that the response speed was much faster in the Time-Limited condition than in the Self-Paced condition, proving that our manipulation of urgency was successful. However, the urgency did not affect the moral evaluations, with average ratings for moral and immoral images that were unchanged in the Time-Limited versus the Self-Paced condition. Within conditions, however, a median-split analysis separating fast from slow responses showed that fast responses were associated with more extreme ratings than slow responses. Taken together, these findings indicate that, while speed is correlated with polarized evaluations, it does not cause participants to give more extreme ratings.

Item-based analysis of the data further underscored that the ratings given to the images were highly consistent across the Time-Limited and Self-Paced conditions, and that extreme ratings (“very moral” and “very immoral”) were associated with faster responses than more moderate ratings. The data pattern is consistent with the decision-difficulty hypothesis, but not the speed-polarization hypothesis. Speed does not cause polarization. Instead, the differences in fast versus slow responses likely reflect the ease of categorization of moral images. Images with salient moral content are categorized faster than more ambiguous images, in line with previous findings from our lab on preference formation, suggesting that longer viewing is associated with cognitive efforts toward disambiguation[31-32].

From the present data, there appears to be no direct analogue of the speed-accuracy tradeoff for subjective decision-making. The level of variation in the moral evaluations also remained unchanged in the Time-Limited versus Self-Paced condition, ruling out any notion of a speed-precision tradeoff. Here, however, we note that we used only one level of time pressure, requiring the participants to respond within 2 s in the Time-Limited condition. While this level of time pressure was strong enough to more than double the speed of responding, it clearly left participants sufficient time to complete their moral evaluations. Future research (e.g., using tachistoscopic presentations) should examine how urgency affects the moral evaluation when the given viewing time falls below the minimal amount needed to complete the normal categorization. Speed does not cause polarization, but it remains possible that, with insufficient time to process the moral aspects of the images, the normal association between fast responses and extreme ratings would break down. Accordingly, one hypothesis would be that, if participants are not given enough time to recognize the image content, they may, in uncertainty, tend to respond toward the middle, with moderate or neutral ratings.

Although we did not find a direct analogue of the speed-accuracy tradeoff in the present study, it is possible that speed causes indirect changes in the moral evaluation performance. Given that the participants were able to reach the same moral evaluations in less than half the time, comparing the Time-Limited versus Self-Paced conditions, it seems reasonable to suggest that a large component of the

response time in the self-paced condition reflected post-decisional processing, or cognitive processing aimed at further information extraction, beyond the amount needed to reach the moral categorization. Recent research on the so-called “moral pop-out” in a lexical decision task with moral and non-moral words has suggested that moral content is prioritized in conscious awareness after perceptual encoding but before memory processing, with discriminatory brain activity as early as 200 ms after stimulus onset[38]. In line with this observation, in the present paradigm participants may have been able to assess the moral content well before proceeding to respond, particularly in the self-paced viewing condition.

It is possible that, without time pressure, the natural tendency would be to continue exploring the image content even after moral categorization, engaging in intrinsically-motivated or curiosity-driven[39] associative information processing and continued semantic inference. If so, it is possible that there would be a tradeoff between speed and the level of processing[40-41], or a speed-memory tradeoff. That is to say, under time pressure, participants would not be able to create detailed episodic memories of the images. If tested, then, participants might show poorer recall and recognition performance for images evaluated under time pressure than for those evaluated in a self-paced condition.

In sum, the present paradigm established that speed is associated with, but does not cause, polarization in the evaluation of real-world images. As such, there is no direct analogue of the speed-accuracy tradeoff in the moral evaluation. Boundary conditions and indirect effects of urgency, however, remain to be investigated.

Declarations

Acknowledgements

This research was supported by project grant JP16H03751 (PI: J.L.) from the Japan Society for the Promotion of Science, and by a Ph.D. scholarship awarded to M.C. by the China Scholarship Council.

Author Contributions

All authors contributed to the design of the study. M.C. programmed the experiments, conducted the data collection for the study, analyzed the behavior, and prepared all figures. M.C. and J.L. wrote the manuscript. All authors reviewed and approved the manuscript.

Additional Information

A preliminary report of part of this work appeared as a chapter in Japanese in the proceedings of the 38th Annual Meeting of the Japanese Cognitive Science Society in 2021.

Supplementary information

A spreadsheet with the present data is made available as supplementary information.

Competing Interests: The authors declare no competing interests.

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Tables

Table 1. Two-way Bayesian repeated-measures ANOVA for evaluation scores.

Effects	P(inclusion)	P(exclusion)	P(incl|data)	P(excl|data)	$BF_{inclusion}$
Morality	0.600	0.400	0.235	0.765	0.204
Time Control	0.600	0.400	0.194	0.806	0.160
Morality × Time Control	0.200	0.800	0.024	0.976	0.100

Table 2. Two-way Bayesian repeated-measures ANOVA for response times.

Effects	P(inclusion)	P(exclusion)	P(incl|data)	P(excl|data)	$BF_{inclusion}$
Morality	0.600	0.400	0.275	0.725	0.253
Time Control	0.600	0.400	1.000	0.000	∞
Morality × Time Control	0.200	0.800	0.076	0.924	0.329

Table 3. Three-way Bayesian repeated-measures ANOVA for evaluation scores, based on median split by response speed.

Effects	P(inclusion)	P(exclusion)	P(incl|data)	P(excl|data)	$BF_{inclusion}$
Time Control (TC)	0.737	0.263	0.532	0.468	0.407
Morality (M)	0.737	0.263	0.309	0.691	0.159
TC × M	0.316	0.684	0.103	0.897	0.248
Response Speed (RS)	0.737	0.263	1.000	3.837e -7	930864.665
TC × RS	0.316	0.684	0.439	0.561	1.693
M × RS	0.316	0.684	0.051	0.949	0.117
TC × M × RS	0.053	0.947	0.003	0.997	0.062

Figures

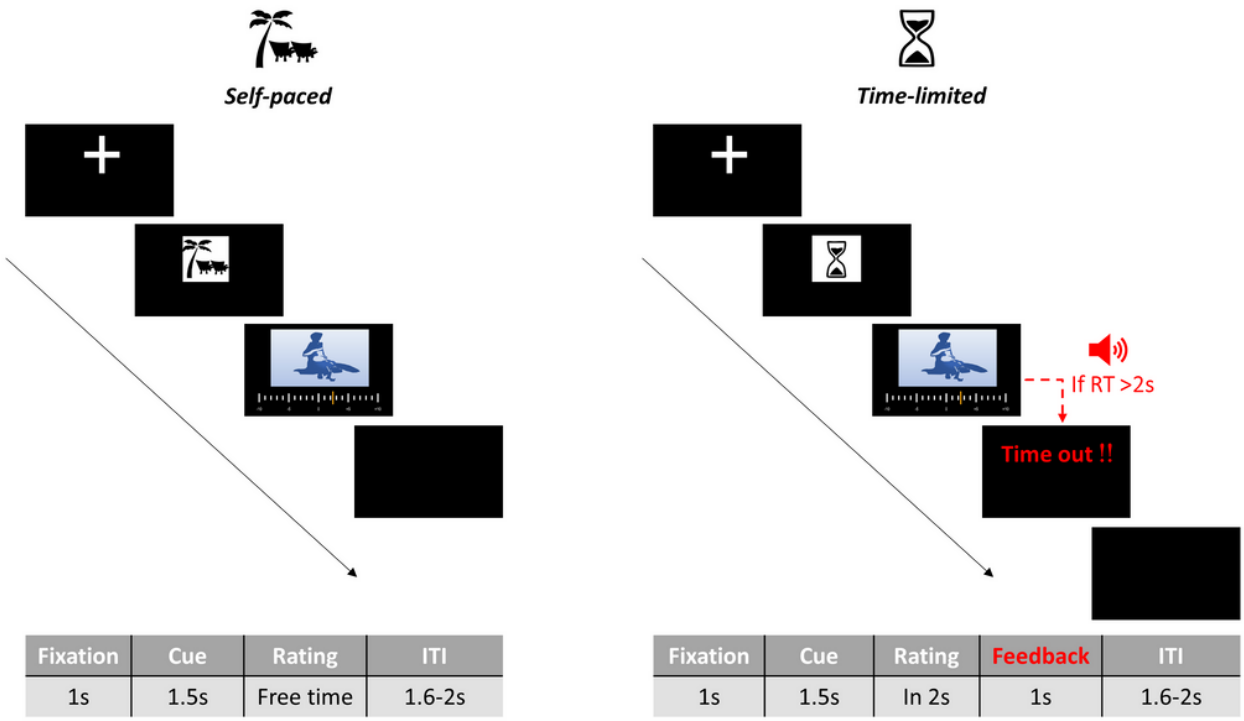

Figure 1

Schematic representation of the experimental paradigm. The trial structure for the Self-Paced condition is shown on the left; the Time-Limited condition, on the right. Both conditions started with a fixation cross for 1 s, followed by a time-instruction cue for 1.5 s. In SP trials, the participants were allowed to view the images as long as they liked before indicating their evaluation. In the TL trials, the participants were required to complete their evaluation within 2 s; if they failed to do so, an error message was presented.

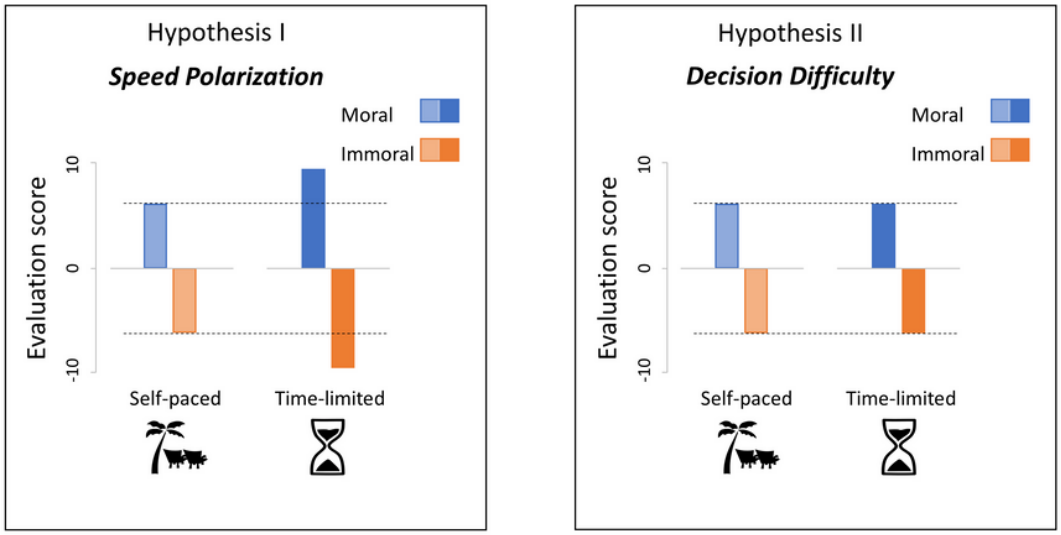

Figure 2

Schematic representation of the alternative hypothesis. Hypothesis I, Speed Polarization, is shown on the left; hypothesis II, Decision Difficulty, is shown on the right. The speed-polarization hypothesis predicted that the evaluation scores would be more extreme in the Time-Limited condition than in the Self-Paced condition. The decision-difficulty hypothesis implied that the moral evaluations would remain unchanged even under urgency.

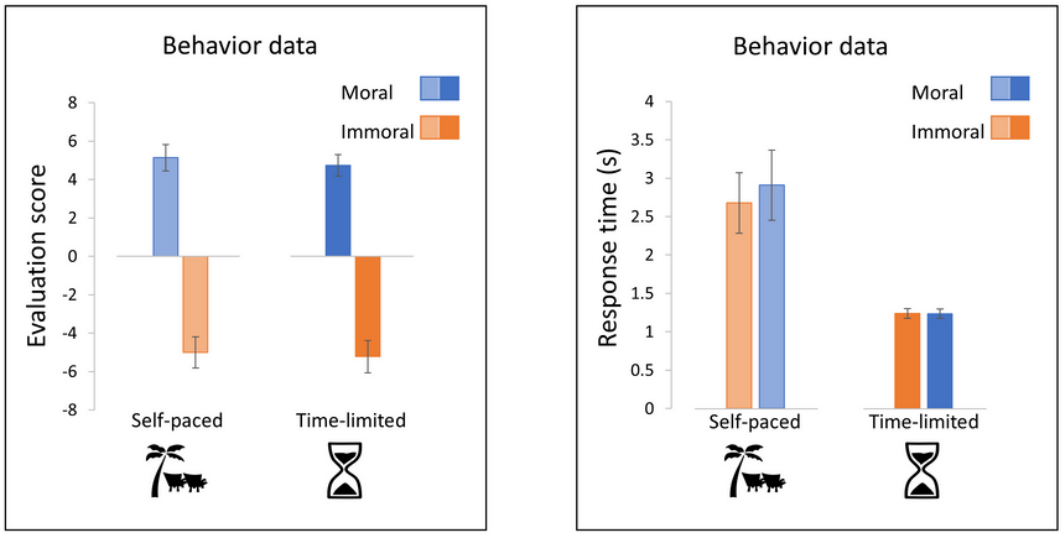

Figure 3

Average evaluations scores (left panel) and response times (right panel) for each participant in each condition (N = 30). The orange bars show the data with moral images; the blue bars represent the data with immoral images. The bars from the TL conditions are shown in a darker shade than the bars from the SP conditions. The error bars reflect the 95% confidence interval around the mean.

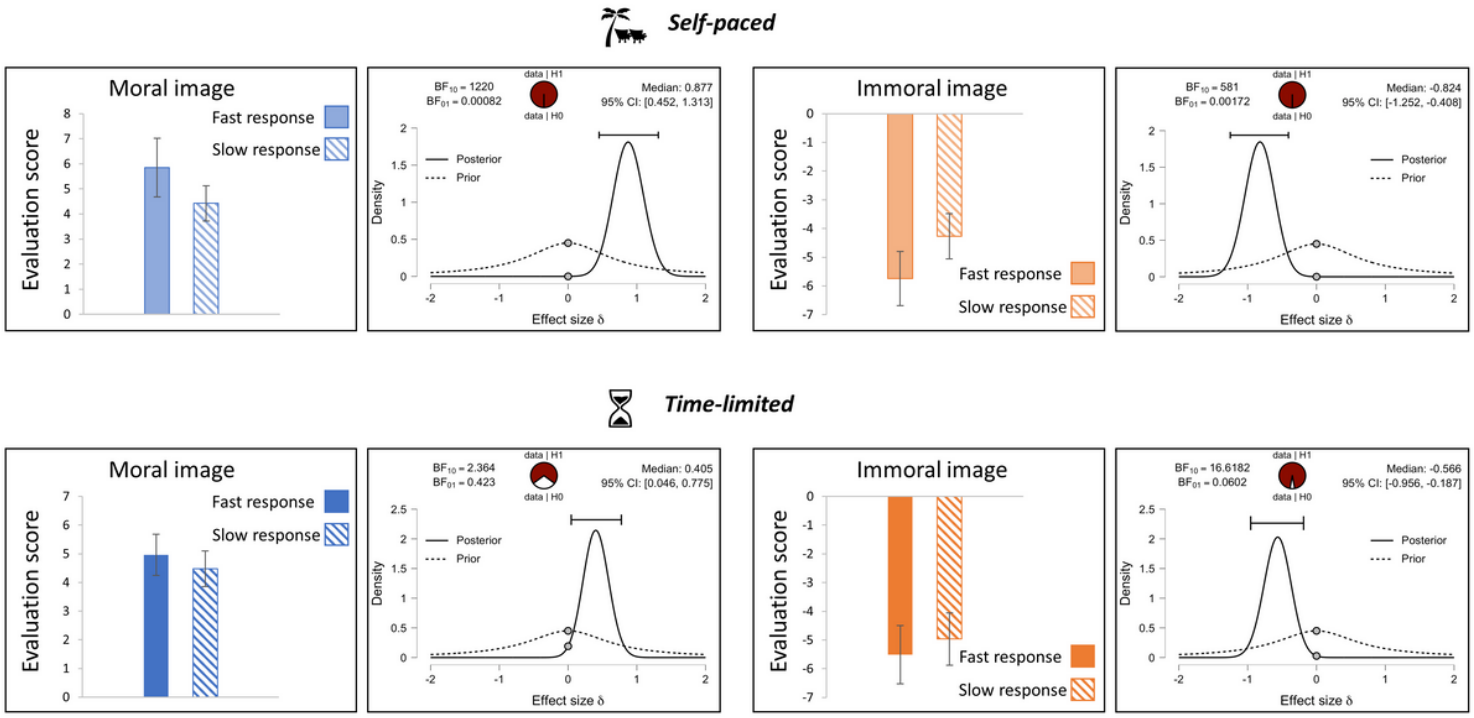

Figure 4

Comparisons between fast responses and slow responses, separately for each condition in the 2 × 2 design with the factors Time Control and Morality, based on the averaged data for each participant (N = 30). The bar graphs show the evaluation scores in each condition; the graphs to the right of each bar graph show the corresponding Bayesian paired t-test, with the prior and posterior distributions in dashed and solid lines, respectively. The error bars reflect the 95% confidence interval around the mean.

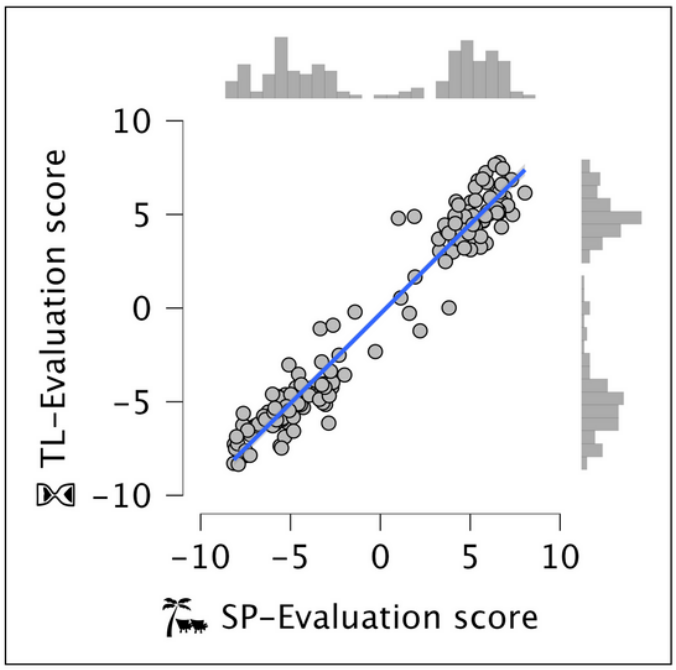

Figure 5

Item-based scatter plot with histograms for the correlation analysis (N = 160) between the evaluation scores in the Self-Paced versus Time-Limited conditions. Bayesian testing gave strong evidence for a positive correlation (see text), depicted here with the linear regression.

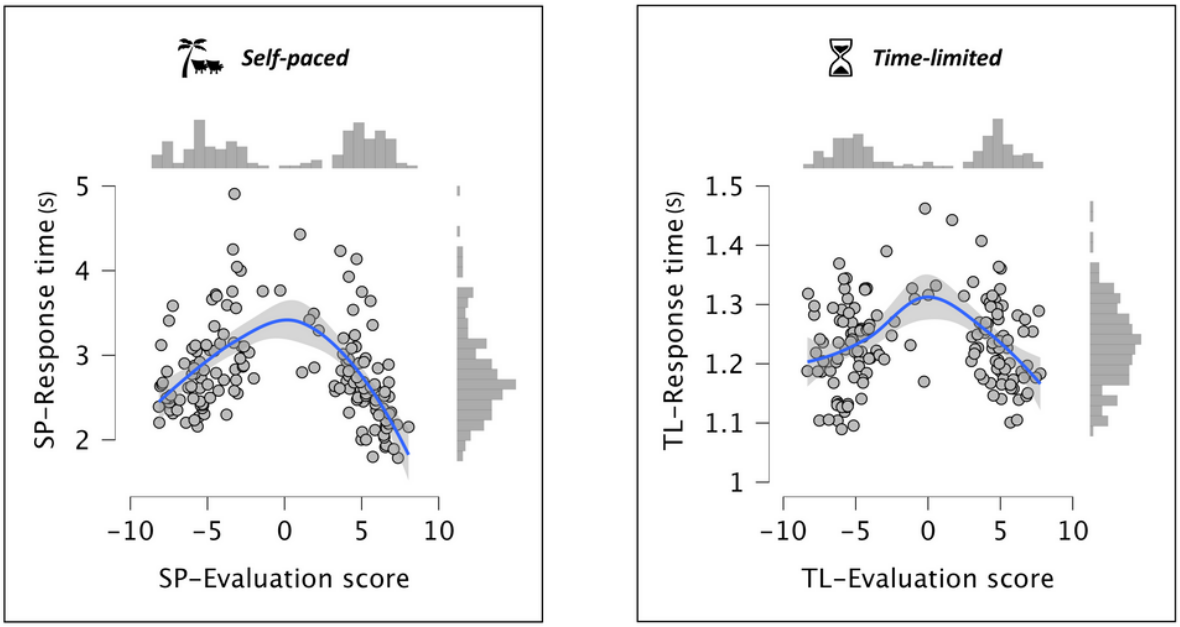

Figure 6

Item-based scatter plots with histograms for the correlation analysis (N = 160) between the evaluation scores and response times. The left panel shows the data in the Self-Paced condition; the right panel shows the data in the Time-Limited condition. Bayesian testing gave no evidence of any correlations; instead, the trends appeared to be parabolic, as shown here with smooth regressions and their 95% confidence intervals.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Madata.xlsx