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**On the memory processes underlying conscious deliberation in complex decision making: The role of  
verbatim and gist memory**

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## Abstract

Studies showed that a distraction period improves complex decision making relative to a conscious deliberation period or an immediate choice. Although this counterintuitive finding was replicated several times, many other studies failed to find any beneficial effect of distraction and some even showed situations in which conscious deliberation was more effective. We suggest that studies showing a conscious thought advantage share several features that may have fostered the encoding and the retrieval of precise verbatim representations of the choice alternatives. The effectiveness of conscious deliberation could thus depend on the availability of verbatim memory. To test this hypothesis we varied the availability of verbatim memory for the attributes of various equivalent alternatives by introducing, for half of the participants, a time delay between the presentation of the alternatives and of a fictitious client request that provides a normative criterion to evaluate them. Verbatim memory declined whereas gist memory increased in the delay relative to the no delay condition. Moreover, there was a detrimental effect of delay in the deliberation condition but not in the distraction and the immediate decision conditions. Both verbatim memory and decision quality after deliberation were affected by the introduction of a delay which suggests that verbatim memory underlies conscious thought effectiveness.

Keywords: unconscious thought effect, conscious thought, verbatim memory, gist memory, decision-making

**On the memory processes underlying conscious deliberation in complex decision making: The role of  
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Imagine you are facing a choice between several alternatives – such as apartments to rent – and your task is to select the best one with regard to some criteria (e.g., the location, the size of the living-room, etc.). Research revealed that the amount of conscious attention dedicated to this complex decision can modulate its quality. Surprisingly, distracting people's attention away for a few minutes can help them to make a better choice relative to when they think consciously about the decision or when they make it immediately (e.g., Dijksterhuis, 2004; Dijksterhuis, Bos, Nordgren, & van Baaren, 2006; Strick, Dijksterhuis, & van Baaren, 2010). This effect was dubbed the “unconscious thought effect” (UTE; Strick et al., 2010) because unconscious processing of decision information is assumed to occur during the distraction period.

In the standard experimental paradigm used to investigate the UTE (e.g., Dijksterhuis, 2004), participants are presented with four objects (e.g., apartments) described by 12 or more positive (e.g., very nice area) and negative (e.g., rather noisy) attributes. In most of the studies, the best alternative is defined normatively as the one with the largest number of positive attributes independently of the weight of each attribute which is considered to be equivalent. Following the presentation of the attributes, participants are assigned to one of three decision modes. In the immediate condition, they are immediately asked either to evaluate the four alternatives or to choose the best one. In the distraction condition, they are prevented from making their decision for 3 or 4 min by engaging in a distracting activity (e.g., completing a n-back task) while in the deliberation condition they have to think carefully about their decision for the same amount of time. Of the studies that used this paradigm, some replicated the UTE, showing that participants who performed the distraction task were more likely to select the best option, some showed no significant difference between decision modes and a few even found better performance in the conscious thought condition (Acker, 2008; Nieuwenstein et al., 2015; Strick et al., 2011, for meta-analyses; Dijksterhuis & Nordgren, 2006; Dijksterhuis & Strick, 2016; Newell & Shanks, 2014, for reviews). Most research focused on elucidating the conditions under which a distraction period could be advantageous and several moderators of the UTE were discovered (Strick et al., 2011). Although studies showed that conscious thought could also be advantageous in some cases, very few of them investigated directly the moderators and processes underlying conscious thought. In the following sections, we review studies showing moderators of conscious thought effectiveness and show that they have commonalities.

Dijksterhuis and colleagues (2006, Exp. 1 and 2) reported two studies showing that while a distraction period led to better decision when the choice involved a total of 48 pieces of information, the best option was

more likely to be picked after a deliberation period when only 16 pieces of information had to be taken into account. To interpret these results, the authors proposed that while conscious thought is well suited for applying strict rules and is limited in capacity, unconscious thought have much larger capacity but only provides rough estimates. A couple of studies indeed demonstrated that conscious thought is well suited for applying rules such as those needed to do simple arithmetic calculations (e.g., Abadie, Villejoubert, Waroquier, & Vallée-Tourangeau, 2013; Payne, Samper, Bettman, & Luce, 2008). For example, Payne and colleagues (see also Ashby, Glöckner, & Dickert, 2011) designed a lottery task with numerical attributes. Participants were asked to choose their preferred lottery among a set of four. Each lottery was characterized by 12 equiprobable events described by a different monetary outcome value from \$0 to \$16. This task differed slightly from Dijksterhuis' choice task since participants were presented with precise numerical values that could be unambiguously ordered instead of qualitative verbal attributes such as "very nice area" or "rather noisy". A deliberation period resulted in better decisions than a distraction period when choices demanded sensitivity to magnitudes and not just to the values (good or bad) of the attributes. In two studies, Abadie and colleagues (2013) also showed that the material used to present information characterizing alternatives moderates conscious deliberation effectiveness. Decision made after deliberation were better than those made immediately or after distraction when options were characterized by precise and quantifiable attributes such as monetary outcome values, whereas no difference between decision modes was found when options were described with qualitative information.

Other studies reported that participants made better decisions after deliberation rather than immediately when they either have the opportunity to encode information thoroughly (e.g., they could ask to have more time to encode the information after the compulsory 3 min) or have the information in front of them (Newell, Wong, Cheung, & Rakow, 2008, Exp. 2). Moreover, Huizenga, Wetzels, Don van Ravenzwaaij, and Wagenmakers (2012, Exp. 2) showed an advantage of conscious thought over distraction when participants did have access to information presented either in a structured or unstructured way while they deliberated their decisions. These studies suggest that conscious deliberation is beneficial for decision making when information can be encoded thoroughly.

More recently, Abadie, Waroquier, and Terrier (2015) reported two experiments showing better decisions after conscious deliberation than immediately or after distraction when information was presented per criterion (i.e., the attributes of the four options on a particular criterion were displayed simultaneously) but not when it was presented per option (i.e., all the attributes of one option were displayed simultaneously). Importantly, these experiments were also aimed at examining the memory retrieval processes underlying each

decision mode. Participants completed a recognition test after the decision phase. Results indicated that recollection was higher when information was presented per criterion relative to the presentation per option. Recollection represents the ability to recover the context and elaboration given to an item when it was initially studied and to use them as a basis of intentionally controlled responding (e.g., Yonelinas, 2002). This increase in recollection explained better decision quality obtained in the conscious thought condition with the per criterion presentation. By contrast, recollection did not underlie the quality of decision made after distraction or immediately. Hence, the ability to initiate recollection process seems to be crucial when deliberating consciously. Congruently, Damian and Sherman (2013) showed that deliberation enhances rule-based processing (similar to the recollection process) relative to a distraction period.

A further experiment (Abadie et al., 2017) showed an advantage of conscious thought when information was presented attribute by attribute thereby replicating earlier finding of Waroquier, Marchiori, Klein, and Cleeremans (2009, Exp. 1). Abadie and colleagues (2017) went a step further by investigating the mental representations underlying each decision mode. According to the Fuzzy Trace theory (FTT, Reyna, 2012; Reyna & Brainerd, 1995) decision making relies on two independent type of representations, verbatim and gist representations. On the one hand, verbatim representations are item-specific traces that capture the exact wording of information (e.g., “*the apartment is located in the centre of the town, in a quiet area and there are local shops*”). On the other hand, gist representations are abstractions of the properties that the studied items have in common. They capture the broader meaning of the information (e.g., “*the apartment is well located*”). Results indicated that presenting the information per attribute increased the retrieval of verbatim representations and this increase explained the better decisions made by participants in the deliberation condition. This extends previous results (Abadie et al., 2015) and suggests that deliberation benefits complex decision making when people intentionally retrieve verbatim representations of relevant information. This experiment (see also Abadie et al., 2013) also showed that verbatim representations do not underlie the quality of decisions made immediately or after distraction. The results rather suggest that gist representations underlie decisions made after distraction, at least partially, and that decisions made immediately are not substantially linked to any kind of memory.

All these studies showed different moderators (encoding time, availability of information, presentation material, presentation format, etc.) of conscious thought effectiveness. These experimental manipulations have in common that they affect the precision with which the decision information can be encoded and processed. Thus, it is likely that all these manipulations, like the presentation format, affect the creation of verbatim traces of

decision information. These verbatim traces are needed to elaborate accurate reasoning during deliberation and to make good decisions.

In the present study, we varied the availability of verbatim memory of the attributes of various alternatives in order to test the hypothesis that exact verbatim representations are crucial for conscious deliberation. It is well established that access to verbatim and gist representations declines over time and that verbatim traces are much faster to fade (e.g., Reyna & Kiernan, 1994). Hence, we manipulated the time interval between the presentation of the attributes of four apartments and of a fictitious client request allowing the evaluation of the apartments. This manipulation should affect the availability of verbatim memory but not of gist memory. The innovative aspect of our study was to investigate the effect of such a manipulation on decision quality. Only decisions made after conscious thought should be affected by such a manipulation as studies showed that decisions made immediately or after distraction are not based on verbatim memory (Abadie et al., 2013, 2017).

The attributes of four apartments were presented one by one as previous studies showed that this presentation format was helpful for conscious thought and led to the formation of strong verbatim traces (Abadie et al., 2015; 2017). Then, for half of the participants, a delay was introduced between the presentation of the apartments and of the client request. This client request provided a normative criterion allowing the evaluation of the alternatives that were otherwise equivalent (see Abadie et al., 2013; 2015; 2017). Therefore, effective conscious or unconscious processing of decision information could only occur after the presentation of the client request. The time delay should reduce verbatim but not gist memory of the attributes of the apartments before the participants have read the client request. Thus, they could not use this time interval to evaluate the apartments. It was a delay of 6 min during which participants watched a neutral documentary. To study the effect of time delay on memory, the time delay is normally set much longer than several minutes such as days or a week (e.g., Reyna & Kiernan, 1994). However, we chose a time delay of 6 min because a pilot study showed that participants could not remember enough information about the alternatives to properly evaluate them after a day (only one of them was able to identify the option that best fitted the client request) and that 6 min was enough to significantly reduce their memory of the alternatives. Moreover, we also wanted that all the participants do the same activity during the time interval and that the new information introduced during this activity does not interfere with decision information. Therefore, we decided to present them a 6 min video tutorial concerning the use of different Internet browsers. For the other half of participants, the client request was presented immediately after the information about the alternatives.

In order to manipulate decision mode, one third of the participants were asked to make a decision immediately after the presentation of the client request, one third was distracted by the completion of an attention-demanding task for 3 minutes and one third had to deliberate about the best option for the client for the same amount of time. Following the decision phase, all the participants completed the conjoint recognition task of the FTT (e.g., Brainerd, Reyna, & Mojardin, 1999) to assess the retrieval of verbatim and gist representations.

We predicted that introducing a 6 min delay between the encoding of information about the apartments and the client request would reduce verbatim memory of the attributes of the apartments but would have no effect on gist memory. Regarding decision quality, we expected an interaction between decision mode and time delay. More specifically, we expected that deliberation would lead to better decisions when there was no time delay and that verbatim traces were strong, relative to when a 6 min delay was introduced and that verbatim traces were weak. By contrast, we did not expect any effect of delay in the immediate and distraction conditions as our previous works suggest that these decision modes are not based on verbatim memory.

## Method

### Participants and design

We computed a meta-analytic effect size across the three studies (Abadie et al., 2016; 2017) that demonstrated that deliberation led to better decision when either verbatim memory or recollection was high relative to when it was weak. The meta-analytic effect size was Cohen's  $d = 0.741$ , 95% CI [0.452, 1.029]. Power analysis indicated that 24 participants per group would be needed to achieve a 80% power (G\*Power; Faul, Erdfelder, Buchner, & Lang, 2009).

The experiment have been approved by the internal ethics committee of the department of psychology of the University of Toulouse<sup>1</sup>. One hundred forty four (71 women) French social sciences students at the University of Toulouse, ranging in age from 18 to 40 ( $M = 22.93$ ,  $SD = 4.79$ ) participated voluntarily. All of them gave their informed consent prior to their inclusion in the study. Data from two participants were excluded due to their accuracy below 3 SD of overall group mean in the two-back task. This task was used in the distraction condition to shift participants' attention away from decision information. Participants were randomly assigned to one of six conditions in a 3 (decision mode: deliberation vs. distraction vs. immediate)  $\times$  2 (delay between the presentation of decision information and client request: no delay vs. 6 min delay) between participants design.

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<sup>1</sup> All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.



## Materials and procedure

Participants were informed that they will have to imagine themselves as a real-estate agent and to decide which apartment among four (labelled Bleu, Vert, Rouge and Violet) best fitted a client request. Each apartment was characterized by a different set of 12 positive and 12 negative attributes pertaining to 24 criteria (Table 1). The criteria were pre-tested by an independent sample of 26 participants to ensure that they were perceived as similar in terms of importance. They had to indicate the importance of 48 criteria on a 10-point scale. We selected the 24 criteria ranging from 5.9 to 8.33 in terms of importance. The client request comprised six of these criteria above the median of the pre-test ratings and six below the median of the ratings. Apartment Bleu was the best for the client. This apartment was positive on the 12 criteria of the request. The three others apartments were of intermediate attractiveness. Each of them was positive on a different set of six criteria of the request.

Insert Table 1 about here

The 24 attributes of one apartment appeared one by one randomly on the screen for 3 seconds each, followed by the attributes of another apartment. The order of appearance of the four apartments was also randomly determined. After processing the information about the apartments, participants were randomly allocated to one of the two time delay conditions. Participants in the delay condition were told that they would watch a documentary for 6 min before reading the client request. They were presented with a video tutorial concerning the use of different Internet browsers. Then, the 12 attributes of the client request appeared in a random order and remained on the screen for 36 seconds. In the no delay condition, participants saw the client request immediately after the presentation of the apartments' attributes.

After being reminded that their task was to choose an apartment to recommend to their client, participants were randomly allocated to one of three decision modes. In the immediate condition, they were immediately asked to evaluate each of the four apartments. As in previous studies (e.g., Dijksterhuis, 2004), participants in the conscious deliberation condition were given 3 min to think carefully about their decision. During this time, a countdown timer appeared on the screen to indicate the remaining time. In the distraction condition, participants were told that the director of the real-estate agency had asked them to perform an urgent secondary task and that it was important to perform this task well. They had to complete a two-back task (Jonides et al., 1997) for 3 min. In this task they were presented with series of numbers and they had to press the space bar whenever the number on the screen was the number that appeared two positions before. Next, all participants rated each apartment on a 10-point scale ranging from 0 *very unattractive for the client* to 9 *very attractive for the client* (subsequently recoded on a 100-point scale).

Finally, participants completed the simplified conjoint recognition task (Stahl & Klauer, 2008; see also Brainerd et al., 1999, Brainerd, Reyna, & Aydin, 2010). Four lists of attributes, one for each apartment, were randomly presented. For each list, participants had to decide whether each attribute had been used to describe the apartment. Each list consisted of 36 attributes: 12 targets, 12 related distractors and 12 unrelated distractors. The attributes were randomly presented. The targets were the 12 positive attributes of each apartment (i.e., for the best apartment, the targets were the attributes of the client request). The related distractors were the 12 other attributes of each apartment but with an opposite value. They were all positive since the 12 other studied attributes were negative for each apartment. The unrelated distractors were non-studied attributes (e.g., electric hob, painted walls, etc.). A different set of unrelated distractors was used for each of the four lists. For each apartment, participants had to indicate whether each attribute was identical to one of the attributes of the apartment previously seen in the study phase (a target), was related to one of the attributes of this apartment, or was new. Figure 1 provides a description of the procedure. Finally, participants were thanked, debriefed and dismissed.

Insert Figure 1 about here

## Results

For all the analyses on memory and decision quality,  $p$ -value are reported when they met a significance criterion of  $p < .05$ . Measures of effect size (Cohen's  $d$  or partial eta squared,  $\eta_p^2$ ) are reported for all  $t$  or  $F$  values  $> 1$ . The data are available in the Open Science Framework repository at <https://osf.io/hwcj6/>

### Verbatim and gist memory

We used the simplified conjoint recognition model of the FTT (e.g., Stahl & Klauer, 2008; see also Brainerd et al., 1999) to compute parameter estimates for verbatim and gist memory and guessing processes. Specifically, the model assumes that responses in the simplified conjoint recognition task can originate from the following parameters: verbatim memory for targets ( $V_t$ ), verbatim memory for related distractors ( $V_r$ ), gist memory for targets ( $G_t$ ), gist memory for related distractors ( $G_r$ ) and guessing processes ( $a$  and  $b$ ). The parameter  $V_t$  represents the probability of retrieving a target's verbatim trace given a target probe as retrieval cue. Retrieving a verbatim trace given a target probe would allow participants to correctly identify the target probe as a target. The parameter  $V_r$  represents the probability of retrieving a target's verbatim trace given a related probe. This would allow participants to correctly identify the related probe as a related distractor. The parameter  $G_t$  represents the probability of retrieving a target's gist trace given a target probe as retrieval cue. The parameter  $G_r$  represents the probability of retrieving a target's gist trace given a related probe. Retrieving a gist trace given a

related or a target probe would allow participants to identify the probe meaning as old, but would not allow them to remember whether the probe itself or a related word with the same gist had been presented in the study phase. Thus, they could identify a target either as target or as related distractor. Similarly, a related probe could be identified either as a target or as a related distractor on the basis of gist retrieval. The guessing parameter  $\alpha$  assesses the tendency to select the response *target* rather than *related* in case of available gist but no verbatim memory and also when an item has been identified as old by the way of guessing (parameter  $b$ ). Parameter  $b$  assesses the tendency to accept targets, related and unrelated probes as old. A representation of the processing tree model of the simplified conjoint recognition paradigm and the model equations are provided in Stahl and Klauer (2008)<sup>2</sup>.

Verbatim, gist and guessing parameter estimates for each experimental condition are given in Table 2. The analyses were based on 3168 observations, that is, 144 probes (48 targets, 48 related and 48 unrelated distractors) per participant. As a rule of thumb for sufficient power, Klauer, Stahl and Voss (2011) suggested that more than 10% of the expected category counts should be below five. With the present sample size, the smallest expected category counts amount to 47.

The fit of the initial model was good,  $G^2(36) = 27.9$ , indicating that the simplified conjoint-recognition model fitted the data well. We compared the parameters across decision modes and delay conditions by setting them equal and observing the impact on model fit. As expected, the parameter  $V_t$  was significantly smaller in the delay condition as compared to the no delay condition,  $\Delta G^2(3) = 14.1, p = .003$ . It was the case for participants in the deliberation,  $\Delta G^2(1) = 3.86, p = .049$ , and the immediate decision conditions,  $\Delta G^2(1) = 8.50, p = .004$ , but not for those in the distraction condition,  $\Delta G^2(1) = 1.75$ . The parameter  $V_r$  was not significantly affected by delay,  $\Delta G^2(3) = 3.59$ . The parameters for gist memory,  $G_t$  and  $G_r$ , were larger in the delay condition than in the no delay condition,  $\Delta G^2(3) = 68.7, p < .001$  and  $\Delta G^2(3) = 35.9, p < .001$ , respectively. It was the case in the three decision modes, deliberation,  $\Delta G^2(1) = 9.47, p = .002$ , distraction,  $\Delta G^2(1) = 11.4, p < .001$ , and immediate decision,  $\Delta G^2(1) = 47.8, p < .001$ , for the parameter  $G_t$ . The parameter  $G_r$  was significantly larger in the delay condition for participants in the distraction,  $\Delta G^2(1) = 25.7, p < .001$ , and the immediate decision conditions,  $\Delta G^2(1) = 47.8, p < .001$  but not for those in the deliberation condition,  $\Delta G^2(1) = 0.48$ . The guessing parameters  $b$  and  $a$  were also affected by the delay,  $\Delta G^2(3) = 156, p < .001$ , and  $\Delta G^2(3) = 35.5, p < .001$ , respectively. Parameter  $b$  was significantly smaller in the delay condition as compared to the no delay condition in the distraction,  $\Delta G^2(1) =$

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<sup>2</sup> Note that memory and guessing parameters are computed per experimental condition in the present study. Hence, a mediation analysis between memory and decision quality cannot be tested.

63.1,  $p < .001$ , and the immediate decision conditions,  $\Delta G^2(1) = 92.5$ ,  $p < .001$ , but it was not significantly affected by delay in the deliberation condition,  $\Delta G^2(1) = 0.85$ . By contrast, parameter  $a$  was significantly larger in the delay condition relative to the no delay condition in the deliberation,  $\Delta G^2(1) = 8.10$ ,  $p = .004$ , and the immediate decision conditions,  $\Delta G^2(1) = 23.7$ ,  $p < .001$ . The effect was marginal in the distraction condition,  $\Delta G^2(1) = 3.71$ ,  $p = .054$

Insert Table 2 about here

### Decision quality

Decision quality was measured by subtracting the mean of the evaluations of the three least attractive apartments from the evaluations of the best apartment (e.g., Waroquier, et al., 2009). Larger values of this index indicate a better differentiation of the best apartment from the others. The mean evaluations of the six groups are shown in Figure 2.

There was no significant main effect of decision mode,  $F(2, 136) < 1$ , nor of delay,  $F(1, 136) < 1$ . Importantly, however, there was a significant interaction between decision mode and delay,  $F(2, 136) = 3.42$ ,  $p = .035$ ,  $\eta_p^2 = .048$ . As expected, the locus of this interaction was due to a significant detrimental effect of delay in the deliberation group,  $t(46) = 2.23$ ,  $p = .031$ ,  $d = .647$ , whereas decision quality was not significantly affected by delay in the immediate,  $t(42) = 1.23$ , and the distraction,  $t(49) < 1$ , groups. As null-hypothesis significance testing (NHST) does not allow to interpret null results, we conducted Bayesian analyses in the distraction and the immediate conditions. Bayesian analyses allow determining whether data provide evidence for the null hypothesis or are simply insensitive (Rouder, Speckman, Sun, Morey, & Iverson, 2009). Bayesian t-tests provided substantial evidence for the absence of effect of delay in the distraction condition ( $BF_{01} = 3.46$ ) and insensitive evidence for the effect of delay in the immediate condition ( $BF_{01} = 1.82$ ).

Insert Figure 2 about here

### Discussion

The present study replicates and extends previous findings (Abadie et al., 2015; 2017) showing that conscious deliberation leads to better decision when verbatim representations of relevant information can be retrieved relative to when such traces are less accessible. A new manipulation of verbatim memory for decision information was made by introducing a 6 min delay between the presentation of choice options and of the client request. As expected, verbatim memory was reduced in the condition in which there was a delay. Moreover, decision quality after a deliberation period was also affected by the introduction of a delay. These findings

suggest that to be effective in complex decision making a conscious deliberation needs to be based on precise verbatim memory for the relevant information.

Contrary to the conscious thought condition, decision quality after distraction was not significantly affected by the delay. This finding is in line with previous results (Li et al., 2014) showing that when information is presented in two temporally partitioned sessions – a manipulation quite similar to the introduction of a delay between the presentation of the options and the client request – distracted participants integrate information in both sessions whereas those in the conscious thought condition overemphasize information in the second session. Interestingly, however, distracted participants were descriptively better when there was a delay ( $M = 51.1$ ;  $SD = 15.1$ ) relative to when there was no delay ( $M = 49.8$ ;  $SD = 16$ ). Moreover, gist memory increased significantly in the delay relative to the no delay condition for distracted participants. This increase in gist memory after a distraction period replicates results of several previous studies (Abadie et al., 2013; 2017). However, contrary to previous studies, the increase in gist memory was not accompanied by a significant improvement of decision quality. It is likely that this representational change mainly occurred during the delay and not during the distraction period as it was the case in previous studies. Indeed, the increase in gist memory was obtained for all decision modes in the delay condition. In addition, since this study was designed to favor conscious thought effectiveness, the conditions were not favorable for decision-making after distraction. Specifically, the information about the options was presented per attribute and other studies showed that this presentation format could be rather detrimental for distraction (Abadie et al., 2015; 2017). Moreover, the distraction task used (e.g., 2-back task) was attentional demanding which could also have impeded the maintenance of information during distraction. Indeed, previous studies demonstrated that performing a high demanding relative to a low demanding distraction is detrimental for decision quality (Abadie, 2013; Waroquier, Abadie, Klein & Cleeremans, 2014). Although introducing a delay led participants to rely more on gist memory, it seems that, due to the inappropriate presentation format and the high demanding distraction task, gist memory could not be used effectively during the distraction period.

As in the distraction condition, immediate decision quality was descriptively better in the delay condition ( $M = 55.6$ ;  $SD = 14.6$ ) relative to the no delay condition ( $M = 49.7$ ;  $SD = 16.8$ ). This difference, although larger than in the distraction condition, did not reach significance. Gist memory increased and verbatim memory decreased in the delay relative to the no delay condition. Hence, as expected, decision quality was not linked to the quality of verbatim traces in the immediate condition. Congruently, other studies demonstrated that the quality of decisions made immediately after the presentation of information was not correlated with the

quality of memory traces (Abadie et al., 2015, 2017). However, gist memory contributed twice more to recognition and possibly to decision making when there was a delay relative to when there was no delay. Moreover, as in the distraction condition, immediate decision quality was descriptively better in the delay condition. Hence, the immediate decision with delay condition could resemble to the classic distraction condition in which gist memory would increase during the delay and this increase could be beneficial for decision quality.

Finally, as pointed out by the FTT, gist-based decision making is usually more adaptive than verbatim-based decision making in real world situations (Reyna, 2018). However, in the present study, decision quality was not significantly improved in the delay condition while gist memory increased. It is presumably because this experiment was aimed at stressing the advantage of deliberation over distraction when verbatim traces of relevant information are available. Thus, the information presentation format used here fostered the formation of verbatim representations which were, in this situation, useful for conscious deliberation (Abadie & Waroquier, in press). Nevertheless, in real world, information can also be acquired in such a way that necessitates gist retrieval for making good choices.

To conclude, this study mainly concerned conscious deliberation effectiveness. It showed that introducing a delay between the presentation of different options and of a client request that should be satisfied reduced the retrieval of verbatim memory and increased gist memory for the options. The decrease in verbatim memory was detrimental for decision quality in the conscious deliberation condition only. This finding provides further evidence that decision quality after a deliberation period is dependent upon the ability to retrieve verbatim memory.

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Table 1. Material of the decision task.

Apartments' attributes	Ratings	Apartments				Client request
		BLEU	VERT	ROUGE	VIOLET	
Public transport nearby/no public transport nearby	8.33 (1.76)	+	-	+	-	+
Located in the center of the town/outside the town	8.31 (1.16)	-	-	-	+	
Separate bedroom/no separate bedroom	8.21 (1.31)	+	+	+	+	+
Quiet/noisy area	8.19 (2.26)	+	-	+	+	
Local shops/no local shops	8.03 (1.31)	-	+	-	+	+
Floor, ceiling and wall coverings in good/poor condition	7.96 (1.71)	+	+	-	-	
Large/small living room	7.8 (1.76)	-	+	-	+	+
Double/single glazing	7.69 (1.89)	+	-	-	+	
Sanitary facilities in good/poor condition	7.65 (1.64)	-	+	+	-	
Electric installation in good/poor condition	7.5 (2.02)	+	-	-	-	+
Large/small storage space	7.5 (1.83)	-	+	-	+	+
Good/bad security system	7.42 (2.23)	-	+	+	-	
Equipped/non-equipped kitchen	6.65 (1.85)	-	-	+	-	+
Gas/electric heating	6.42 (2.02)	+	+	-	+	
Not overlooked / overlooked	6.35 (2.21)	+	+	-	+	
Good/bad orientation	6 (2.8)	+	+	-	-	
Leisure opportunities in the neighborhood/no leisure opportunities	6 (1.76)	+	+	+	-	+
Balcony/no balcony	6 (2.29)	-	-	+	-	+
Parking space/no parking space	6 (3.35)	+	-	+	+	+
District not earmarked for development/earmarked for development	5.96 (2.41)	-	-	-	+	
Well/non-furnished	5.92 (2.97)	-	+	+	-	+
Janitor/no janitor	5.9 (3.07)	-	-	-	+	
Cellar/no cellar	5.9 (1.76)	+	-	+	-	+
Separate entrance/no separate entrance	5.9 (2.89)	-	-	+	-	

Note. A “+” or “-” indicates that the apartment has positive or negative version of the attribute. The average (in parenthesis standard deviation) ratings of the attributes were obtained in a pilot study.

Table 2. Verbatim, gist and guessing parameter estimates as a function of decision mode and delay. Values in brackets are 95% confidence intervals.

	$V_t$	$V_r$	$G_t$	$G_r$	$b$	$a$
<b>Deliberation</b>						
No delay	0.15 (0.04;0.25)	0.13 (0.01;0.25)	0.69 (0.64;0.74)	0.70 (0.65;0.76)	0.14 (0.12;0.16)	0.48 (0.40;0.56)
Delay	0.00 (-0.18;0.18)	0.13 (0.03;0.23)	0.78 (0.74;0.83)	0.74 (0.69;0.79)	0.13 (0.11;0.15)	0.62 (0.53;0.70)
<b>Distraction</b>						
No delay	0.30 (0.22;0.37)	0.00 (-0.14;0.14)	0.71 (0.66;0.76)	0.78 (0.74;0.82)	0.25 (0.22;0.28)	0.41 (0.35;0.46)
Delay	0.35 (0.25;0.45)	0.00 (-0.18;0.18)	0.81 (0.76;0.85)	0.88 (0.85;0.91)	0.11 (0.09;0.14)	0.45 (0.36;0.54)
<b>Immediate</b>						
No delay	0.28 (0.22; 0.34)	0.00 (-0.11;0.11)	0.55 (0.49;0.62)	0.65 (0.59;0.71)	0.36 (0.33;0.39)	0.40 (0.36;0.45)
Delay	0.09 (-0,04;0.23)	0.11 (0.01;0.21)	0.80 (0.76;0.85)	0.74 (0.70;0.79)	0.18 (0.16;0.20)	0.56 (0.49;0.63)

Note.  $V_t$  = verbatim memory for targets;  $V_r$  = verbatim memory for related distractors;  $G_t$  = gist memory for targets;  $G_r$  = gist memory for related distractors;  $b$  = guessing that an item is either a target or a related probe ;  $a$  = guessing "target".

Figure 1. Diagram of the experimental procedure

Figure 2. Decision quality as a function of decision mode and delay. Error bars show 95% confidence intervals.