The Role of Circadian Variations and Socially Distributed Thinking in Belief Perseverance

Gaëlle Villejoubert (G.Villejoubert@kingston.ac.uk)
Madiha Khan (k0801532@kingston.ac.uk)
Frédéric Vallée-Tourangeau (F.Vallee-Tourangeau@kingston.ac.uk)
Department of Psychology, Penrhyn road
Kingston upon Thames, KT1 2EE United Kingdom

Abstract

From the moment they make up their mind, people are reluctant to change it. We tested the hypothesis that people disposing of more cognitive resources—through circadian variations or socially distributed thinking—would engage in deliberative thinking and would consequently be less likely to exhibit belief perseverance. Perseverance was measured by the change in judgments related to a suspect in a criminal case, following the presentation of an offender profile that was at odds with the suspect's description. Individuals tested at a compatible circadian time exhibited less perseverance in the face of contradictory evidence compared to individuals tested at an incongruent time. Individuals deliberating on their own also tended to show more belief perseverance compared to those who worked in groups. There was, however, no interaction effect between circadian timing and condition of deliberation on belief change. The implications for our understanding of the mechanisms that underpin belief perseverance are discussed.

Keywords: Belief perseverance; Dual-process accounts of cognition; Circadian variations; Socially distributed cognition.

Introduction

Despite the public release of his birth certificate, a 2011 Gallup poll published by USA Today revealed that only 38% of Americans definitely believed President Obama was born in the US (Adams, 2011). Although the President was reportedly "puzzled" by the persistence of these rumors, this incident illustrates a well-established finding in psychological science: it is easier to get people to believe something new than to get them to abandon an existing belief even in the face of indisputable evidence to the contrary—a phenomenon known as *belief perseverance* (Ross, Lepper & Hubbard, 1975).

Belief perseverance may concern beliefs about one's own skills and abilities, those of others, as well as naïve theories about stereotypical traits and behaviors (Anderson, 2007). In their seminal study of perseverance in social perception, Ross et al. (1975) presented a series of cards containing a real and a fictitious suicide note and asked participants to decide which note was written by a patient with suicidal ideation. Participants first received false feedback on their performance and were later debriefed on the arbitrary nature of the feedback they received. Yet, when participants were asked to reassess their performance after the thorough debriefing, those judgments remained strongly influenced by the initial spurious test results they had received.

A combination of three types of cognitive processes have been implicated in the perseverance of beliefs (Anderson & Lindsay, 1998): the availability heuristic, its associated illusory correlation effect, and the anchoring and adjustment heuristic (Tversky & Kahneman, 1974). Events such as a performance appraisal or the observation of a person's behavior are presumed to initiate the generation of a causal explanation (e.g., "*I am (un)skilled at this task*"). This new belief thereafter remains available in memory, independently of the inceptive evidence such that when the evidence is discredited, the belief remains intact (Anderson, Lepper, & Ross, 1980).

Attempts to alleviate belief perseverance have been met with mitigated success. The most effective approach has been to encourage individuals to consider alternative causal explanations—counterexplanations—in an effort to reduce the influence of the inceptive belief (Anderson, 1982, 2007). Yet, considering alternatives may sometimes backfire. When individuals are given the opportunity to discount negative evidence, for example by plausibly discrediting it, the availability of counterexplanations no longer reduces belief perseverance (Vallée-Tourangeau, Beynon, & James, 2000). Moreoever, perseverance is aggravated when evidence for the alternative explanation is difficult to elicit or when evidence for the target hypothesis is easily accessible (Nestler, 2010).

The mitigated success of the counterexplanation account, we wish to argue, can be best accounted for within a dual-process framework. The dual-process view of cognition has gained considerable influence in the past decade in research examining judgment, decision-making or reasoning (e.g., see Darlow & Sloman, 2010 for a review) but has yet to be applied to the study of belief perseverance. According to this view, two families of cognitive processes may underpin judgments and decisions: an intuitive mode of cognitive functioning—where judgments originate from rapid and automatic processes—and a second, more deliberate and effortful mode of thinking engaging processes which can either be at the origin of the judgment provided or simply monitor its quality (Kahneman, 2003). The type of heuristic processing that is taken to underpin belief perseverance is a trademark of the intuitive heuristic mode of thinking. This suggests that any situation either favoring deliberative thinking or augmenting deliberative thinking capacity should lead to a decrease in belief perseverance. We examine this possibility by investigating the role of two

variations in cognitive resources on belief perseverance: circadian preferences and socially distributed thinking.

Several studies have demonstrated that the efficiency of executive control—a key feature of deliberative thinking—is contingent upon the synchronicity between people's peak period of circadian arousal and the time of testing (for a review, see Schmidt, Collette, Cajochen, & Peigneux, 2010). For example, West, Murphy, Armilio, Craik and Stuss (2002) used a choice reaction time task placing variable demands upon working memory: individuals were asked to identify and respond to the spatial location of a target presented in a previous display either with or without a distractor that they had to ignore. Time-of-day variations had an effect on performance, but only when more controlled processes were involved (e.g., when a distractor had to be inhibited); performance on simpler trials requiring automatic processes was unaffected by circadian variations. Schmidt et al. (2010) reviewed this and other studies pointing to similar results and concluded that cognitive functioning at nonoptimal time of day was typically associated with failure to clear or suppress irrelevant information and difficulties to resist predominant responses even if they are incorrect. For example, Bodenhausen (1990) showed that people were less likely to rely on stereotypic preconceptions when rendering judgments at a time of day that was congruent with their circadian preferences.

From a dual-process perspective, these results suggest that circadian congruence fosters the optimal deployment of cognitive resources, enabling people to engage in more effortful deliberative thinking. In turn, circadian incongruence encourages more heuristic and less effortful thinking, and hence lead people to unquestionably rely on established beliefs and stereotypic preconceptions. In light of the importance of circadian congruence for effortful deliberation, we hypothesized that belief change should be greater in a task where people are asked to revise a prior belief in light of new conflicting evidence at a time congruent with their circadian preference.

If depleted cognitive resources lead to belief perseverance, augmenting those resources may counteract the effect of circadian variations. We tested this possibility by examining the impact of socially distributed cognition on belief perseverance. From a distributed cognition perspective, cognitive functioning is conceived as taking place in a system including resources and operations that are distributed across time, material artefacts as well as people (Hollan, Hutchins, & Kirsh, 2000; Villejoubert & Vallée-Tourangeau, 2011). From this perspective, interactivity acts as a cognitive scaffold, resulting in improved performance. For example, we showed that when participants could interact with physical matchsticks in a matchstick algebra problem, they were more likely to achieve insight compared to those for whom matchsticks were drawn on paper (Weller, Villejoubert, & Vallée-Tourangeau, 2011; see also Vallée-Tourangeau, Euden, & Hearn, 2011).

Unlike material distribution, the contribution of socially distributed resources for performing a cognitive task remains debated, however; with wealth of evidence showing that performance may be both weakened or strengthened when cognition is shared in a group (Larson, 2010). Group performance may vary depending on the fit between members' cognitive resources and the cognitive demands of the task, how resources are distributed, and process costs arising from group interactions (Steiner, 1972). On the one hand, groups may benefit from the potential to generate a more diverse range of interpretations and counter-explanations than would individuals (Hutchins, 1991). For example, multiple-cue judgments were shown to be more accurate when they originated from dyads rather than individuals (Olsson, Juslin, & Olsson, 2006). Yet, it is not clear that groups will always be in a better position to engage in deliberative thinking as the superiority of groups may also depend on the cognitive resources they have at their disposal (Hutchins, 1991). This suggests, for example, that groups composed of individuals with limited cognitive resources may function worse than individuals, exhibiting more heuristic thinking and "groupthink" (Janis, 1982) whereas groups composed of members at the peak of their cognitive functioning may outperform individuals.

Our study was therefore also designed to examine whether the amount of cognitive resources available to individuals in a group (manipulated through circadian variations) would affect group performance. We expected that groups would exhibit less belief perseverance than individuals when they were made of individuals tested at their best period of circadian arousal. Conversely, we expected belief perseverance to be more pronounced in groups than in individuals when groups were composed of individuals tested at an incongruent circadian time.

The Present Study

The present study investigated the cognitive processes that underpin belief perseverance by examining the moderating role of circadian variations and socially distributed thinking. It used a forensic scenario where participants were asked to revise their initial judgment of the extent to which a stereotypical suspect was guilty of an offense, after being presented with counterevidence in the form of an atypical offender profile written by an expert profiler. Guilt judgments were produced either by small groups of three participants or by individual participants. Half of the individual participants and groups were tested at a time that was congruent with their optimal circadian preference; the rest were tested at an incongruent time. Building upon previous research on the role of circadian variations on thinking mode, we expected that people who were tested at an incongruent time would exhibit greater belief perseverance because their limited cognitive resources should favor a heuristic mode of thinking. We also explored the role of socially distributed thinking on belief perseverance and hypothesized that the relative performance of groups compared to individuals would depend on

whether or not groups were composed of members functioning at their optimal time of circadian arousal: groups of individuals tested at a congruent time were expected to revise their guilt judgment to a greater extent than individuals while groups of individuals tested at an incongruent time were expected to persevere more in their belief of guilt compared to individuals.

Method

Participants

A total of 129 students and administrative staff were recruited on the campus of Kingston University. They were either tested individually (N = 32, Mean age = 29 years, SD = 12.85, 22 women) or in one of 32 small groups made of three to four individuals (see Table 1 for group demographics).

Table 1: Group demographics.

Group type	N	Mean age (SD)
Women only	5	25 (9.33)
Men only	3	22 (2.46)
Mixed (2W/1M)	12	23 (6.65)
Mixed (1W/2M)	12	23 (5.60)
Total	32	23 (6.48)

Design

The experiment used a 2 × 2 × 2 mixed design. The between-subject independent variables were the time of testing (circadian-congruent or circadian-incongruent) and testing condition (individually or in small groups). The within-subject independent variable was the time of judgment (before or after the presentation of disconfirming information). Participants were randomly allocated to one of the resulting four conditions.

Procedure

Participants were invited to take part in a study examining how jurors make decisions in various circumstances. Participants' circadian type was assessed using the abridged English Version of Morningness-Eveningness questionnaire (rH&O, Chelminki et al., 2000). They were categorized as either Morning (M) types or Evening (E) types on the basis of a median split of their scores. M-types scored significantly higher on the Morningness-Eveningness dimension compared to E-types; $M_{\text{M-types}}$ = 17.00 (SD = 3.36), N = 34, $M_{\text{E-types}}$ = 11.57 (SD = 1.36), N = 30, $t(64)$ = 7.31, $p < .001$. All participants were then reconvened to complete a small questionnaire. Half of the participants were tested at a time that was congruent with their circadian preferences (M-types tested between 10am and 12noon and E-types tested between 1pm and 5pm) while the remaining half was tested at an incongruent time. Participants were asked, on their own or in a small group, to read a brief description of a criminal case involving a series of sexual assaults against young girls, followed by a stereotypical description of a suspected child molester (e.g., a 44-year-old white male, unemployed, lonely and morally deviant). Lastly, they read an atypical offender profile by a forensic expert, which listed characteristics informed by actual statistics for this kind of offender although at odds with the stereotypical suspect description (e.g., "In most crimes of this nature the offender is employed in some form of skilled or office job"; see Marshall and Alison, 2007, for the complete descriptions). Participants tested in groups were invited to read the case information on their own and thereafter discuss the case between themselves before reporting a unique group estimate for each of the variables measured.

Measures

Participants were asked to consider the case and rate the degree to which the suspect may be guilty and the degree to which they felt confident that their judgment was correct (1=not at all, 10=completely) both before and after the presentation of the atypical profile. Finally, participants were asked to rate their level of involvement in the case (1=none, 10=greatly) and how difficult it was to make a decision (1=not at all, 10=very) before they were debriefed and thanked for their participation.

Results

Manipulation Checks

Participants tested at a congruent circadian time reported a slightly higher level of involvement in the task, $M_{\text{congruent}}$ = 6.55, SD = 2.36 vs. $M_{\text{incongruent}}$ = 5.88, SD = 2.56, as well as higher levels of difficulty, $M_{\text{congruent}}$ = 6.23, SD = 2.35 vs. $M_{\text{incongruent}}$ = 5.74, SD = 2.21. Possibly due to lack of statistical power, however, neither difference reached statistical significance; $t(62) = 1.08$, $p = .14$, one-tailed, Cohen's $d = 0.27$ for involvement, and $t(62) = 0.87$, $p = .19$, one-tailed, Cohen's $d = 0.22$ for difficulty.

Guilt Judgments

The theoretically important patterns in these data are (i) the effect of time of judgment (before or after the presentation of the profile), which captured the degree to which participants, regardless of circadian congruence or grouping, changed their guilt ratings after seeing the atypical offender profile; (ii) the interaction between circadian congruence and time of ratings (see Fig. 1); (iii) the interaction between group and time of ratings (see Fig. 2); and finally (iv) the interaction between circadian congruence and group (see Fig . 3).

Guilt judgment data were analyzed with a 2 (circadian-congruent vs. circadian-incongruent) × 2 (individual vs. group) × 2 (before vs. after the atypical profile presentation) mixed analysis of variance (ANOVA). The main effect of time of testing (congruent or incongruent with circadian preferences) was not significant, $F < 1$, nor was the main effect of testing condition (individually or in small group), $F(1, 60) = 1.25$. However, there was a significant main

effect of the time of judgment, M_{before} = 7.26 (*SD* = 1.52) vs. M_{after} = 5.44 (*SD* = 2.07), $F(1, 60) = 47.23$, $MSE = 2.35$, $p < .001$, $\eta^2_p = .44$. There was also a significant interaction between circadian time of testing and the time of judgment, as Figure 1 illustrates, $F(1, 60) = 4.65$, $p = .04$, $\eta^2_p = .07$. Guilt judgments were significantly revised downwards both at circadian-congruent times, $t(29) = 6.02$, $p < .001$, and at circadian-incongruent times, $t(33) = 3.46$, $p = .002$. However, as anticipated, the difference in pre- and post-profile judgments was significantly smaller, indicative of more belief perseverance, under circadian-incongruent time of testing, $t(62) = -2.13$, $p = .02$, one-tailed.

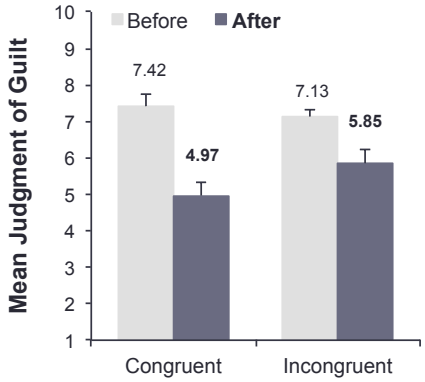

Figure 1: Mean judgments of the extent to which the suspect may be guilty before and after the presentation of the atypical offender profile, as a function of time of testing (circadian congruent or incongruent)

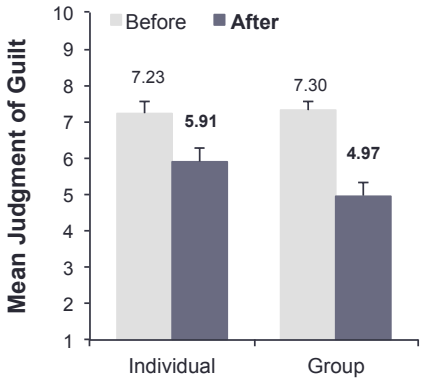

Figure 2: Mean judgments of the extent to which the suspect may be guilty before and after the presentation of the atypical offender profile, as a function of testing condition (individual or group)

The interaction between time of judgment (before or after the presentation of the profile) and testing condition was also marginally significant, $F(1, 60) = 3.44$, $p = .07$, $\eta^2_p = .05$. Both judgments made by individuals, $t(31) = 3.20$, $p = .003$, and those made by groups, $t(31) = 6.36$, $p < .001$, were significantly revised downwards after the presentation of the atypical profile (see Fig. 2). However, the amount of belief revision was larger in group judgments, $t(62) = 1.81$, $p = .04$, one-tailed.

Of less theoretical interest, the effect of testing condition on guilt judgments collapsed across time of testing was also moderated by circadian congruency, $F(1, 60) = 4.50$, $MSE = 3.89$, $p = .04$, $\eta^2_p = .07$ (see Fig. 3). Unplanned post-hoc tests (with a Bonferroni-corrected α set at .0125) revealed that testing condition did not affect overall guilt judgments when participants were tested at a congruent time, $t(28) = -.61$. However, guilt judgments made individually were significantly higher than those made in groups when participants were tested at an incongruent time, $t(32) = 2.72$. These results show that individual and group guilt judgments collapsed across time of testing were indistinguishable when produced at circadian congruent times whereas individual judgments of guilt were more pronounced than group judgments at incongruent circadian times.

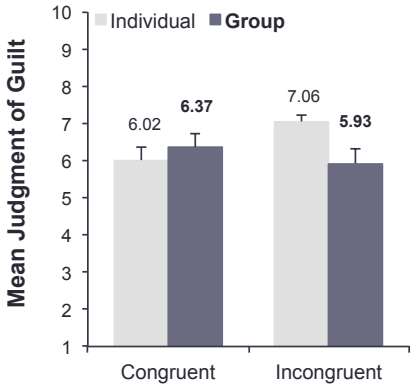

Figure 3: Mean overall judgments of the extent to which the suspect may be guilty as a function of time of testing and testing condition

Finally, the three-way interaction term was not significant, $F < 1$. As Figure 4 illustrates, the effect of circadian time congruency on belief revision was the same for individuals and for groups, albeit groups tended to revise their judgments to a greater extent compared to individuals, in line with the findings reported above.

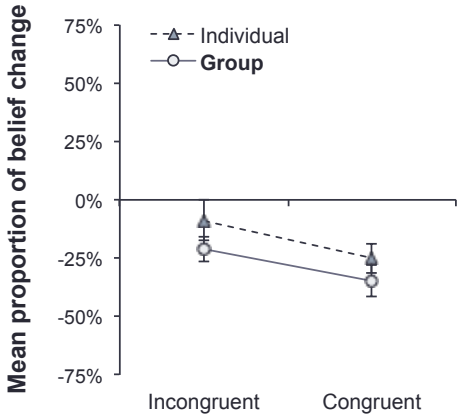

Figure 4: Mean proportion of belief change as a function of time of testing and testing condition

Discussion

This study aimed to shed new light on the mitigated success of the counterexplanation approach to reduce belief perseverance. We proposed that belief perseverance originated from a heuristic mode of cognitive processing whereas belief revision demanded an effortful, deliberative processing of the task information, more taxing in cognitive resources. This assumption led us to hypothesize that belief perseverance would be less likely to occur in situations where cognitive resources were unconstrained. We examined two such situations: times when individuals' period of circadian arousal was at its peak and situations when individuals' cognitive resources may be augmented by socially distributed thinking.

Our findings confirmed that the degree of belief persistence in the suspect's guilt after the profile presentation was moderated by circadian congruency: when tested at a congruent time, participants exhibited less belief persistence—that is, they revised their guilt judgment to a greater extent—than when they were tested at an incongruent time. Contrary to what one might expect from the groupthink perspective, but in line with predictions from the distributed cognition perspective, group judgments tended to exhibit less belief perseverance in the suspect's guilt after presentation of the atypical profile—judgments made in groups were revised more substantially than individual judgments. There was, however, no interaction between circadian time of testing and testing condition: group judgments exhibited less belief perseverance than individual judgments, both at congruent and incongruent circadian times of testing.

These findings contribute to our understanding of the cognitive mechanisms that may underpin belief perseverance. They suggest that belief perseverance is not only a consequence of the *content* of thought—for example, the availability of reasons for or against a target belief or a counterexplanation (Anderson, 1982, 2008)—but is also influenced by the cognitive resources available to individuals, which in turn determine the *mode* of thought they can apply to the task. As such, this study provides empirical support for the claim that belief perseverance arises from a heuristic mode of thinking since perseverance was more marked when cognitive resources were limited, thus inhibiting a more effortful and deliberative processing of the task. More importantly, simply increasing the pool of cognitive resources available to process the task—either by testing individuals at their peak circadian time or by allowing them to distribute cognitive resources in a social system—was sufficient to significantly reduce belief perseverance.

The fact that we found no evidence of "groupthink" when groups were tested at incongruent circadian times may suggest that the increased pool of cognitive resources offered by socially distributed thinking remained sufficient to counteract heuristic thinking. Distributed thinking enhances cognitive power by, notably, lowering the cost of sense making. According to Kirsh (2010), distributed thinking involves three cost structures: the cost of mental operations, the cost of outer operations—in the present research, most typically exemplified by the speech acts (Austin, Urmson, & Sbisà 1975) performed by the group members—and the coupling cost of coordinating these inner and outer processes. This suggests in turn, that the superior performance of groups tested at incongruent circadian times occurred because the benefits of socially distributing thinking continued to outweigh the cost of inner cognitive processes and the coupling costs. Future research may shed light on this possibility by increasing coupling costs. One strategy to do so could be to distribute the information about the suspect and the profile between group members as opposed to present all information to all members, as was the case in this study; this would require group members to engage in the coordination of evidence, and this added cost might eliminate the superior performance of groups in incongruent circadian conditions.

Finally, our findings also have implications for past accounts of belief perseverance. They suggest that instructions to consider counterexplanations may succeed by inviting deeper processing of the belief revision task and may fail when the cognitive cost of this type of processing is either too high or when individuals' cognitive resources are depleted. Alternative accounts (e.g., Nestler, 2010; Sanna, Schwarz, & Stocker, 2002) have suggested that judgments are mediated by metacognitive feelings of difficulty. For instance, Nestler (2010) suggested that individuals infer the likelihood of the truth of an outcome—be it the target belief or the counterexplanation—from the difficulty they experience in generating many reasons for (or against) this outcome. This metacognitive explanation does not seem to be supported by our present results: if anything, individuals tended to perceive the task as more difficult when they were tested at congruent circadian times and yet, this was also when they exhibited less belief perseverance.

Future research may thus benefit from disentangling the respective impact of metacognitive feelings of difficulty and mode of thinking. Specifically, an alternative account of Nestler's (2010) findings could be made in terms of the cognitive demands of the task and their impact on the mode of thinking elicited. Prompting for a few reasons in favor of the target belief may be the least demanding and thus unlikely to engage a deliberative mode of thinking. Prompting for many reasons supporting the target belief or prompting for a few reasons supporting the alternative hypothesis might be sufficient to engage more deliberative processes and, as a result, reduce belief perseverance. But prompting for many reasons supporting the alternative explanation may be too taxing in cognitive resources: it entails holding both the target and alternative hypothesis in working memory while also exerting efforts to find a large amount of evidence for the alternative hypothesis. Unless they are motivated to do so, people will more naturally consider multiple evidence in support of one hypothesis rather than establishing the diagnostic value of a single

piece of information for two hypotheses (Villejoubert & Vallée-Tourangeau, 2012). The increasing demand on cognitive resources in this instance could thus have led to cognitive overload, causing people to revert to a heuristic mode of thinking and, as a result, exhibit more belief perseverance.

To conclude, employing circadian congruence as a proxy for the cognitive resources available to perform a judgment task, this research suggests that belief perseverance results from an intuitive mode of thinking. Contrary to what might be anticipated by the groupthink perspective, however, depleted cognitive resources in a group setting did not affect belief perseverance. This suggests that socially distributed thinking may help to counteract the detrimental effect of cognitive depletion.

Acknowledgments

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