

Review Article

When Prediction Errors Become Beliefs: Temporal Alignment and Affective Appraisal in Misinformation

Denis Brouillet^{1,2}

1. Epsilon Laboratory, Université Montpellier Paul Valéry, France; 2. Licaé Laboratory, Université Paris-Nanterre, France

Surprise, or prediction–perception discrepancy, plays a central role in attention and learning, yet its contribution to belief formation and misinformation remains poorly understood. We propose a temporally constrained account in which prediction errors influence belief only when they are aligned with the moment information is encountered, become subjectively accessible, and are transformed through affective appraisal into subjective evidence for truth. This framework integrates predictive processing, fluency theory, and misinformation research, and generates testable predictions about belief formation and information sharing.

Corresponding author: Denis Brouillet, d.brouillet@yahoo.fr

Introduction

Misinformation poses a central challenge for contemporary societies^[1], yet the mechanisms through which false information comes to be experienced as credible remain incompletely understood.

Existing accounts emphasize cognitive biases^[2], motivated reasoning^[3], failures of analytic thinking^[4]^[5], emotional influences^[6], and belief-to-behavior inference^[7]. However, these approaches do not fully explain how information acquires a sense of truth at the moment it is evaluated.

Processing fluency has been shown to influence truth judgments^{[8][9][10][11]} and to increase belief in misinformation^[12]. However, rather than reflecting fluency per se, recent work suggests that perceived fluency depends on discrepancies between expected and experienced processing dynamics^[13]. Importantly, discrepant fluency effects are not always reliable: they are less consistently observed with

perceptual fluency^[14] than with conceptual fluency^[15]. One explanation is that when conceptual fluency is low, perceptual fluency becomes a more salient cue for judgment^[16].

We propose a temporally constrained account in which prediction errors influence belief only when they are aligned with the moment information is evaluated, become subjectively accessible, and are transformed through affective appraisal into subjective evidence for truth.

Core Theoretical Contribution

The surprise arising from prediction error—the discrepancy between expectation and experience that gives rise to perceived fluency—does not influence belief simply by existing, but only when it is experienced at the right moment. When temporally aligned with evaluation, these signals become subjectively accessible and are transformed into epistemic evidence through affective appraisal (Figure 1).

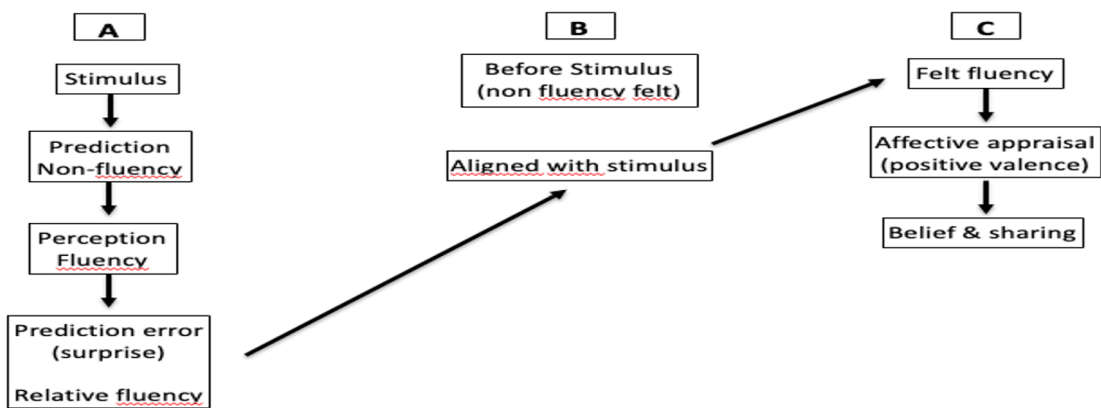


Figure 1. Temporal alignment and affective appraisal in belief formation. **A**, Prediction errors arise from discrepancies between expected and experienced processing dynamics and can give rise to relative fluency when they become subjectively accessible. **B**, The epistemic impact of these signals is temporally gated: prediction errors influence belief only when they occur during evaluation, but not when they arise before. **C**, Once accessible, these signals undergo affective appraisal (positive valence) and are interpreted as cues for plausibility, increasing both belief and willingness to share information, including misinformation.

Fluency and Prediction Error

Fluency is typically defined as the subjective experience of ease in cognitive processing^{[17][18]}. Over time, the concept has been refined along several dimensions. Whittlesea and Leboe^[19] distinguished between

absolute and relative fluency. Absolute fluency refers to the subjective experience of ease in current processing, whereas relative fluency emerges from violations of expectations and reflects the surprise experienced when perceived fluency exceeds anticipated non-fluency.

Reber, Wurtz, and Zimmermann^[20] distinguished between objective and subjective fluency. Objective fluency refers to processing facilitation that does not reach conscious awareness, whereas subjective fluency includes a phenomenal component—an experienced feeling of ease. Yoo et al.^[21] further distinguished between *felt* and *unfelt fluency*, capturing whether processing facilitation is phenomenologically accessible.

These distinctions converge on a key insight: not all aspects of processing fluency are accessible to consciousness. We argue that fluency becomes consciously accessible when prediction–perception discrepancies generate surprise, consistent with a predictive processing account^{[22][23][24]}. Crucially, such prediction errors influence belief only when they are temporally aligned with evaluation.

Temporal Alignment

According to the relative fluency framework, the anticipation of non-fluency—and the resulting surprise—gives rise to the experience of fluency. Brouillet and Friston^[25] proposed that fluency is not directly perceived; rather, what becomes accessible are changes in attentional dynamics triggered by violations of prediction.

Similarly, Brouillet and Friston^[25], like Yoo et al.^[21], distinguish between *unfelt* and *felt fluency*, albeit in a different sense. Unfelt fluency refers to processing facilitation that orients attention toward unexpected input without entering awareness. When such signals become the target of higher-order processes, such as evaluation or judgment, they become consciously accessible as felt changes in processing dynamics.

Consequently, surprise—that is, the transition from unfelt to felt fluency—influences belief only when it occurs during evaluation, as only then can it be attributed to the stimulus being judged.

Affective Appraisal

Appraisal theories posit that emotions arise from the evaluation of stimuli in relation to goals and expectations^{[26][27][28][29]}. Within this framework, surprise reflects the detection of prediction violations.

Unlike other basic emotions, surprise arises rapidly and enhances attentional salience^[30]. Its valence, however, remains debated. Some accounts suggest that surprise is inherently negative due to its association with disruption^{[31][32]}, whereas others argue that its valence depends on contextual interpretation^{[33][34]}.

We propose that surprise is not intrinsically valenced, but acquires affective meaning through appraisal processes, transforming prediction errors into evaluative signals.

Metacognitive Inference

Cognitive processes are accompanied by subjective experiences that serve as cues for judgment. Jacoby and colleagues proposed that memory experiences arise from inferences based on such cues, particularly fluency^{[35][36][37]}.

Fluency is phenomenologically transparent to its causes^[38], requiring attributional inference^[39]. Such inferences guide judgments across domains, including memory, perception, and evaluation.

We propose that belief emerges as a temporally constrained metacognitive inference grounded in affectively appraised and temporally aligned signals.

Misinformation

Misinformation poses a major societal challenge, yet its experiential basis remains underexplored. Existing accounts focus on cognitive biases and reasoning failures, but do not fully explain how information becomes subjectively credible.

Fluency influences belief^{[8][9]} but its effects are variable. We propose that misinformation becomes persuasive when prediction errors are temporally aligned with evaluation, become subjectively accessible, and are interpreted through affective appraisal as cues for plausibility.

By aligning prediction errors with evaluation and amplifying their affective impact, misinformation becomes not only more likely to be believed, but also more likely to be shared.

Predictions and experimental paradigms

The present framework generates clear, testable predictions about when and how processing dynamics influence belief. Specifically, it predicts that prediction–perception discrepancies affect belief only when

they are temporally aligned with evaluation and interpreted through affective appraisal.

First, the temporal alignment hypothesis can be tested by manipulating the timing of discrepant fluency relative to judgment. Discrepancies introduced **during** evaluation should influence belief, whereas those occurring **before** should have little or no effect. This design provides a direct test of temporal gating.

Second, the role of affective appraisal can be assessed by measuring subjective valence and arousal alongside belief judgments. The model predicts that the effect of prediction error on belief will be mediated by affective responses, indicating that processing dynamics become epistemically relevant through appraisal rather than fluency per se.

Third, attribution manipulations can test whether processing signals must be linked to the target to influence judgment. If disfluency is attributed to an external source, its effect on belief should be attenuated or eliminated.

Fourth, we can examine the distinction between fluency and relative fluency by comparing how awareness affects each. It is expected that fluency will be more strongly influenced than relative fluency. Therefore, even when aware, the surprise associated with relative fluency would still influence beliefs.

Fifth, the model predicts that the same processing signal will be interpreted differently depending on task demands. A single manipulation of fluency should influence truth judgments, memory judgments, or evaluative judgments in distinct ways, reflecting task-dependent metacognitive inference.

Finally, the framework can be extended to misinformation by using ecologically valid stimuli, such as social media content. Misinformation should be more persuasive and more likely to be shared when prediction errors are temporally aligned with evaluation and amplified through affective appraisal.

Together, these paradigms test the central claim that belief is not determined by the presence of cognitive signals, but by their temporal alignment with evaluation and their transformation into epistemic evidence through affective appraisal.

Discussion

The present framework proposes that belief is not determined solely by information content, but by the temporal and affective dynamics of cognitive processing. Specifically, prediction–perception discrepancies influence belief only when they are experienced in synchrony with evaluation and interpreted through affective appraisal.

This account provides a unifying explanation for variability in fluency effects. Rather than being inherently unstable, fluency influences belief only when processing dynamics are both temporally aligned and attributed to the target. In this sense, belief emerges from a temporally constrained metacognitive inference grounded in subjective experience.

The framework also clarifies the role of affect. Surprise does not carry a fixed valence but acquires meaning through appraisal, allowing prediction errors to function as cues for plausibility. This mechanism links cognitive and emotional processes within a single inferential system.

Applied to misinformation, the model suggests that false information becomes persuasive when it generates prediction errors that are experienced at the moment of evaluation and amplified through affective appraisal. Under these conditions, processing experiences are transformed into epistemic evidence, increasing both belief and sharing.

More broadly, this perspective shifts the study of belief from static biases to dynamic processes unfolding over time. It suggests that interventions may be more effective when targeting the timing and interpretation of cognitive signals rather than reasoning alone.

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Declarations

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.