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Reconceptualizing Metacognitive Experience in Dual-Process Reasoning: The Role of Emotion in Triggering Deliberation

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Abstract

Human thinking has long been posited to involve two different cognitive processes, also known as intuition and deliberation. While deliberation is effortful and cognitively costly, intuition is effortless. A central issue for reasoning theories is to account for the trigger of deliberation. Compelling theories explain the trigger of deliberative processes by the existence of a metacognitive experience. A feeling of rightness, of error, or of uncertainty would accompany our intuitions and, depending on their strength, triggers the need to use deliberation. Despite the emotional component that can be assumed in these metacognitive phenomena, and a whole literature linking emotion to cognition, these models do not fully embrace the emotional nature of these experiences, both empirically and theoretically. We believe that the psychology of reasoning, and particularly dual-process theories, would benefit from fully accepting this emotional dimension of reasoning.

Keywords: Appraisal; Deliberation; Dual-process; Emotion; Reasoning

There is a long-standing distinction in psychology between intuitive and deliberative reasoning. While intuition is fast and effortless, deliberation is slow and mentally costly (Epstein, 1994; Evans, 2006; James, 1890; Kahneman, 2003; Sloman, 1996; Stanovich & West, 2000). Nonetheless, a central challenge for current theories of reasoning is explaining what triggers deliberation (De Neys, 2023; De Neys & Glumicic, 2008; Pennycook, Fugelsang, & Koehler, 2015; Thompson, Prowse Turner, & Pennycook, 2011). Indeed, deliberative

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reasoning demands significant mental resources (Evans & Stanovich, 2013), which is particularly unpleasant (David, Vassena, & Bijleveld, 2024). Therefore, it is unclear why our cognitive system would appeal to costly deliberation at all to solve a problematic situation rather than settling for the first intuition that comes to mind (even for a suboptimal intuition).

Recent models suggest that deliberative reasoning is activated when intuitive reasoning has failed or produced weak intuitions (Evans & Stanovich, 2013; Kahneman, 2011). An intuition can be considered weak or failing if it takes too long to emerge (Ackerman & Thompson, 2017; Thompson, Evans, & Campbell, 2013). Alternatively, multiple inconsistent intuitions may emerge simultaneously and compete for the response, a phenomenon described as cognitive conflict (De Neys, 2012, 2014; De Neys, Moyens, & Vansteenwegen, 2010; De Neys & Pennycook, 2019). Whether intuitive reasoning has produced no intuition, a weak intuition, or a cognitive conflict, it does not provide a direct and assertive response to a problem.

Current models propose that a metacognitive process assesses the quality of intuitions. When they are deemed unsatisfactory, deliberative reasoning is activated (De Neys, 2023; Pennycook et al., 2015; Thompson et al., 2011). For instance, a “feeling of rightness” (FOR) would result from an evaluation of our confidence in our intuitive answer (Thompson et al., 2011). Fluent intuitions would generate a strong FOR (Thompson & Johnson, 2014; Thompson, Pennycook, Trippas, & Evans, 2018; Thompson et al., 2013), such that deliberation would be unnecessary. Other terminologies have been used, including *Feeling of Error/Wrongness* (Ackerman & Thompson, 2017; Fernandez Cruz, Arango-Muñoz, & Volz, 2016; Gangemi, Bourgeois-Gironde, & Mancini, 2015) or *Response Uncertainty* (De Neys, 2023).

However, the nature of the metacognitive process remains conceptually imprecise. On the one hand, models appear to instantiate a process that is primarily cognitive in nature (i.e., a quantitative quality check). On the other hand, the terms used also imply that metacognitive judgment is something that individuals experience. However, they all fall short of considering the possible emotional nature of such assessment.

In fact, several studies have shown that reasoning tasks are often accompanied by affective reactions (De Neys et al., 2010; Morsanyi & Handley, 2012; Purcell, Roberts, Handley, & Howarth, 2023; Thompson & Morsanyi, 2012; Trippas, Handley, Verde, & Morsanyi, 2016). This growing body of evidence invites us to consider that such reactions go beyond a metacognitive feeling—as understood in Frijda’s (1986) minimal sense, involving subjective experience and valence—and may instead reflect a full emotional response, including characteristics such as action tendencies and behavioral expressions (Berger, Mitschke, Dignath, Eder, & Steenbergen, 2020).

According to the Appraisal Theory of Emotion, an emotion arises from the assessment of the congruence between the goals and the environment of individuals (Moors, Ellsworth, Scherer, & Frijda, 2013; Scherer & Moors, 2019). A stimulus in the external or internal environment is assessed through appraisals of novelty, valence, agency, coping potential, uncertainty and control, and elicits physiological and action tendencies.

In the context of reasoning, this framework suggests that weak intuitions may be appraised as a threat because people prefer predictability over uncertainty (Gawronski & Strack, 2012; Mendes et al., 2007; Proulx, Inzlicht, & Harmon-Jones, 2012), fluency is assessed as posi-

tive (Ackerman & Thompson, 2017; Efklides, 2008; Morsanyi & Handley, 2012; Thompson, 2009; Thompson et al., 2011; Thompson & Morsanyi, 2012; Touroutoglou & Efklides, 2010), and disfluency or discontinuity are assessed as harmful (Dreisbach & Fischer, 2012, 2015; Hajcak, 2012; Hajcak & Foti, 2008; Proulx et al., 2012; Topolinski, Likowski, Weyers, & Strack, 2009).

The appraisal of discontinuity thus generates a negative emotion that motivates the trigger of deliberation. Accordingly, numerous studies have shown that emotions close to doubt, like confusion (Craig, Graesser, Sullins, & Gholson, 2004; D'Mello & Graesser, 2014; VanLehn, Siler, Murray, Yamauchi, & Baggett, 2003; Vogl, Pekrun, Murayama, Loderer, & Schubert, 2019) or state anxiety (e.g., Ashcraft & Kirk, 2001; Blanchette & Caparos, 2016; Channon & Baker, 1994; Darke, 1988; Derakshan & Eysenck, 1998; Kensinger & Corkin, 2003; Moran, 2016), promote deep analytical reasoning.

A number of findings suggest that deliberation leads to a reduction in negative emotion. First, working memory, which is central to reasoning (De Neys, Vartanian, & Goel, 2008), has been related both to negative affect reduction (Hendricks & Buchanan, 2016) and to enhanced emotional control (Schmeichel, Volokhov, & Demaree, 2008). Strategies of emotional regulation also include cognitive changes (e.g., reappraisal; Goldin, McRae, Ramel, & Gross, 2008; Gross, 1998), problem-solving (Haley, 1992; Kraft, Ebner, Leo, & Lindenberg, 2023), involve altering the meaning or relevance of an event through deliberative thinking, and are particularly effective at modifying anxiety-provoking situations (Gross & Thompson, 2007).

We note that emotions often understood as positive, such as surprise or curiosity, motivate deliberation. However, recent theories propose that they are linked to a lack of knowledge accompanied by a (negative) sensation of deprivation, which is small enough that it can be overcome by projecting the pleasure experienced by fulfilling the lack of knowledge (Noordewier & Breugelmans, 2013; van Lieshout, de Lange, & Cools, 2021). In addition, while some personality traits such as a high need for cognition or growth mindset might suggest that deliberation is inherently pleasurable for some individuals, cognitive effort is experienced as aversive even among these individuals (Kurzban, 2016; Kool & Botvinick, 2014, 2018; Shenhav et al., 2017), but they present a motivational capacity allowing them to reinterpret discomfort as a meaningful signal of potential value, triggering engagement and persistence despite the cost (Yeager & Dweck, 2012; Gheza, Kool, & Pourtois, 2023; van Lieshout et al., 2021; Zerna, Strobel, & Strobel, 2024).

Furthermore, we argue that metacognitive process is not enough to explain the trigger of deliberation. In fact, FOR is thought to arise from cues, some of which are affective. For example, a fluent intuition may produce positive affect, which then informs that the intuitive response is right (Thompson & Morsanyi, 2012; Thompson et al., 2011). In this light, FOR is posterior to the appraisal of fluency and the affective reaction that follows. The experience of fluency itself is appraised as goal-congruent, thereby eliciting a positive affective signal, which is then used to build FORs. From this perspective, metacognitive models may be uneconomical in their capacity to explain why deliberation is triggered as the elicited emotion already exists. Moreover, situational modifications—such as instructing participants to reflect—can effectively promote the use of deliberation (Daniel & Klaczynski, 2006; Evans, Handley, Neilens, & Over, 2010; Evans, Newstead, Allen, & Pollard, 1994; Newstead,

Pollard, Evans, & Allen, 1992; Vadeboncoeur & Markovits, 1999). In these cases, what has been altered is the situation itself. The resulting shift in cognitive strategy may stem from a change in the evaluation of the situation by the reasoner and cannot be solely explained by metacognitive evaluations.

In sum, we propose that the trigger of deliberative reasoning is an affective process grounded in appraisal mechanisms. When individuals encounter a situation that is appraised as incongruent with their goals, a negatively valenced emotion is generated, which we identify as doubt (Dewey, 1910; Peirce, 1877). We suggest that this emotion functions as an aversive signal that motivates the individual to interrupt automatic processing and consider alternative responses through deliberative reasoning. Importantly, doubt does not in itself constitute a metacognitive judgment; rather, it represents the emotional signal forming the basis upon which FOR is constructed (Ackerman & Thompson, 2017; Thompson & Morsanyi, 2012). By integrating this emotional signal with dual-process and metacognitive models, our account may explain both the conditions under which deliberation is triggered and why individuals often seek to minimize it—because deliberative reasoning hurts.

Conflict of Interest Statement

We have no known conflict of interest to disclose.

References

- Ackerman, R., & Thompson, V. A. (2017). Meta-reasoning : Monitoring and control of thinking and reasoning. *Trends in Cognitive Sciences*, 21(8), 607–617. <https://doi.org/10.1016/j.tics.2017.05.004>
- Ashcraft, M. H., & Kirk, E. P. (2001). The relationships among working memory, math anxiety, and performance. *Journal of Experimental Psychology: General*, 130(2), 224–237. <https://doi.org/10.1037/0096-3445.130.2.224>
- Berger, A., Mitschke, V., Dignath, D., Eder, A., & Steenbergen, H. (2020). The face of control: Corrugator supercillii tracks aversive conflict signals in the service of adaptive cognitive control. *Psychophysiology*, 57(4), 1–13. <https://doi.org/10.1111/psyp.13524>
- Blanchette, I., & Caparos, S. (2016). Working memory function is linked to trauma exposure, independently of post-traumatic stress disorder symptoms. *Cognitive Neuropsychiatry*, 21(6), 494–509. <https://doi.org/10.1080/13546805.2016.1236015>
- Channon, S., & Baker, J. (1994). Reasoning strategies in depression: Effects of depressed mood on a syllogism task. *Personality and Individual Differences*, 17, 707–711. [https://doi.org/10.1016/0191-8869\(94\)90148-1](https://doi.org/10.1016/0191-8869(94)90148-1)
- Craig, S., Graesser, A., Sullins, J., & Gholson, B. (2004). Affect and learning: An exploratory look into the role of affect in learning with AutoTutor. *Journal of Educational Media*, 29(3), 241–250. <https://doi.org/10.1080/1358165042000283101>
- Daniel, D. B., & Klaczynski, P. A. (2006). Developmental and individual differences in conditional reasoning: Effects of logic instructions and alternative antecedents. *Child Development*, 77(2), 339–354. <https://doi.org/10.1111/j.1467-8624.2006.00874.x>
- Darke, S. (1988). Anxiety and working memory capacity. *Cognition and Emotion*, 2(2), 145–154. <https://doi.org/10.1080/02699938808408071>
- David, L., Vassena, E., & Bijleveld, E. (2024). The unpleasantness of thinking : A meta-analytic review of the association between mental effort and negative affect. *Psychological Bulletin*, 50(9), 1070–1093. <https://doi.org/10.1037/bul0000443>

- De Neys, W. (2012). Bias and conflict: A case for logical intuitions. *Perspectives on Psychological Science*, 7(1), 28–38. <https://doi.org/10.1177/1745691611429354>
- De Neys, W. (2014). Conflict detection, dual processes, and logical intuitions: Some clarifications. *Thinking and Reasoning*, 20, 169–187. <https://doi.org/10.1080/13546783.2013.854725>
- De Neys, W. (2023). Advancing theorizing about fast-and-slow thinking. *Behavioral and Brain Sciences*, 46, e111. <https://doi.org/10.1017/S0140525X2200142X>
- De Neys, W., & Glumicic, T. (2008). Conflict monitoring in dual process theories of thinking. *Cognition*, 106(3), 1248–1299. <https://doi.org/10.1016/j.cognition.2007.06.002>
- De Neys, W., Moyens, E., & Vansteenwegen, D. (2010). Feeling we're biased: Autonomic arousal and reasoning conflict. *Cognitive, Affective, & Behavioral Neuroscience*, 10(2), 208–216. <https://doi.org/10.3758/CABN.10.2.208>
- De Neys, W., & Pennycook, G. (2019). Logic, fast and slow: Advances in dual-process theorizing. *Current Directions in Psychological Science*, 28(5), 503–509. <https://doi.org/10.1177/0963721419855658>
- De Neys, W., Vartanian, O., & Goel, V. (2008). Smarter than we think: When our brains detect that we are biased. *Psychological Science*, 19(5), 483–489. <https://doi.org/10.1111/j.1467-9280.2008.02113.x>
- Derakshan, N., & Eysenck, M. W. (1998). Working memory capacity in high trait-anxious and repressor groups. *Cognition and Emotion*, 12, 697–713. <https://doi.org/10.1080/026999398379501>
- Dewey, J. (1910). *How we think*. Heath and Co.
- D'Mello, S., & Graesser, A. (2014). Confusion and its dynamics during device comprehension with breakdown scenarios. *Acta Psychologica*, 151, 106–116. <https://doi.org/10.1016/j.actpsy.2014.06.005>
- Dreisbach, G., & Fischer, R. (2012). Conflicts as aversive signals. *Brain and Cognition*, 78(2), 94–98. <https://doi.org/10.1016/j.bandc.2011.12.003>
- Dreisbach, G., & Fischer, R. (2015). Conflicts as Aversive Signals for Control Adaptation. *Current Directions in Psychological Science*, 24(4), 255–260. <https://doi.org/10.1177/0963721415569569>
- Efklides, A. (2008). Metacognition: Defining its facets and levels of functioning in relation to self-regulation and co-regulation. *European Psychologist*, 13(4), 277–287. <https://doi.org/10.1027/1016-9040.13.4.277>
- Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist*, 49(8), 709–724. <https://doi.org/10.1037/0003-066X.49.8.709>
- Evans, J. S. B. T. (2006). The heuristic-analytic theory of reasoning: Extension and evaluation. *Psychonomic Bulletin & Review*, 13(3), 378–395. <https://doi.org/10.3758/BF03193858>
- Evans, J. S. B. T., Handley, S. J., Neilens, H., & Over, D. (2010). The influence of cognitive ability and instructional set on causal conditional inference. *Quarterly Journal of Experimental Psychology*, 63(5), 892–909. <https://doi.org/10.1080/17470210903111821>
- Evans, J. S. B. T., Newstead, S. E., Allen, J. L., & Pollard, P. (1994). Debiasing by instruction: The case of belief bias. *European Journal of Cognitive Psychology*, 6(3), 263–285. <https://doi.org/10.1080/09541449408520148>
- Evans, J. S. B. T., & Stanovich, K. E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on Psychological Science*, 8(3), 223–241. <https://doi.org/10.1177/1745691612460685>
- Fernandez Cruz, A. L., Arango-Muñoz, S., & Volz, K. G. (2016). Oops, scratch that! Monitoring one's own errors during mental calculation. *Cognition*, 146, 110–120. <https://doi.org/10.1016/j.cognition.2015.09.005>
- Frijda, N. H. (1986). *The emotions*. Cambridge University Press.
- Gawronski, B., & Strack, F. (Eds.). (2012). *Cognitive consistency: A fundamental principle in social cognition*. The Guilford Press.
- Gangemi, A., Bourgeois-Gironde, S., & Mancini, F. (2015). Feelings of error in reasoning—In search of a phenomenon. *Thinking & Reasoning*, 21(4), 383–396. <https://doi.org/10.1080/13546783.2014.980755>
- Gheza, D., Kool, W., & Pourtois, G. (2023). Need for cognition moderates the relief of avoiding cognitive effort. *PLoS One*, 18(11), e0287954. <https://doi.org/10.1371/journal.pone.0287954>
- Goldin, P. R., McRae, K., Ramel, W., & Gross, J. J. (2008). The neural bases of emotion regulation: Reappraisal and suppression of negative emotion. *Biological psychiatry*, 63(6), 577–586. <https://doi.org/10.1016/j.biopsych.2007.05.031>

- Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, 2(3), 271–299. <https://doi.org/10.1037/1089-2680.2.3.271>
- Gross, J. J., & Thompson, R. A. (2007). Emotion regulation: Conceptual foundations. In J. J. Gross & B. Q. Ford (Eds.), *Handbook of emotion regulation* (pp. 3–24). New York: The Guilford Press.
- Hajcak, G. (2012). What we've learned from mistakes: Insights from error-related brain activity. *Current Directions in Psychological Science*, 21(2), 101–106. <https://doi.org/10.1177/0963721412436809>
- Hajcak, G., & Foti, D. (2008). Errors are aversive: Defensive motivation and the error-related negativity. *Psychological Science*, 19(2), 103–108. <https://doi.org/10.1111/j.1467-9280.2008.02053.x>
- Haley, J. (1992). *Problem-solving therapy*. John Wiley & Sons.
- Hendricks, M. A., & Buchanan, T. W. (2016). Individual differences in cognitive control processes and their relationship to emotion regulation. *Cognition & Emotion*, 30(5), 912–924. <https://doi.org/10.1080/02699931.2015.1032893>
- James, W. (1890). *The Principles of psychology*. Henry Holt and Company.
- Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist*, 58(9), 697–720. <https://doi.org/10.1037/0003-066X.58.9.697>
- Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux.
- Kensinger, E. A., & Corkin, S. (2003). Effect of negative emotional content on working memory and long-term memory. *Emotion*, 3, 378–393. <https://doi.org/10.1037/1528-3542.3.4.378>
- Kool, W., & Botvinick, M. (2014). A labor/leisure tradeoff in cognitive control. *Journal of Experimental Psychology: General*, 143(1), 131–141. <https://doi.org/10.1037/a0031048>
- Kool, W., & Botvinick, M. (2018). Mental labour. *Nature Human Behaviour*, 2(12), 899–908. <https://doi.org/10.1038/s41562-018-0401-9>
- Kraft, L., Ebner, C., Leo, K., & Lindenberg, K. (2023). Emotion regulation strategies and symptoms of depression, anxiety, aggression, and addiction in children and adolescents: A meta-analysis and systematic review. *Clinical Psychology: Science and Practice*, 30(4), 485–502. <https://doi.org/10.1037/cps0000156>
- Kurzban, R. (2016). The sense of effort. *Current Opinion in Psychology*, 7, 67–70. <https://doi.org/10.1016/j.copsyc.2015.08.003>
- Mendes, W. B., Blascovich, J., Hunter, S. B., Lickel, B., & Jost, J. T. (2007). Threatened by the unexpected: Physiological responses during social interactions with expectancy-violating partners. *Journal of Personality and Social Psychology*, 92(4), 698–716. <https://doi.org/10.1037/0022-3514.92.4.698>
- Moors, A., Ellsworth, P. C., Scherer, K. R., & Frijda, N. H. (2013). Appraisal theories of emotion: State of the art and future development. *Emotion Review*, 5(2), 119–124. <https://doi.org/10.1177/1754073912468165>
- Moran, T. P. (2016). Anxiety and working memory capacity: A meta-analysis and narrative review. *Psychological Bulletin*, 142(8), 831–864. <https://doi.org/10.1037/bul0000051>
- Morsanyi, K., & Handley, S. J. (2012). Logic feels so good—I like it! Evidence for intuitive detection of logicity in syllogistic reasoning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 38(3), 596–616. <https://doi.org/10.1037/a0026099>
- Newstead, S. E., Pollard, P., Evans, J. S. B. T., & Allen, J. L. (1992). The source of belief bias effects in syllogistic reasoning. *Cognition*, 45(3), 257–284. [https://doi.org/10.1016/0010-0277\(92\)90019-e](https://doi.org/10.1016/0010-0277(92)90019-e)
- Noordewier, M. K., & Breugelmans, S. M. (2013). On the valence of surprise. *Cognition and Emotion*, 27(7), 1326–1334. <https://doi.org/10.1080/02699931.2013.777660>
- Peirce, C. S. (1877). The fixation of belief. *Popular Science Monthly*, 12, 1–15.
- Pennycook, G., Fugelsang, J. A., & Koehler, D. J. (2015). What makes us think? A three-stage dual-process model of analytic engagement. *Cognitive Psychology*, 80, 34–72. <https://doi.org/10.1016/j.cogpsych.2015.05.001>
- Proulx, T., Inzlicht, M., & Harmon-Jones, E. (2012). Understanding all inconsistency compensation as a palliative response to violated expectations. *Trends in Cognitive Sciences*, 16(5), 285–291. <https://doi.org/10.1016/j.tics.2012.04.002>
- Purcell, Z. A., Roberts, A. J., Handley, S. J., & Howarth, S. (2023). Eye movements, pupil dilation, and conflict detection in reasoning: Exploring the evidence for intuitive logic. *Cognitive Science*, 47(6), e13293. <https://doi.org/10.1111/cogs.13293>

- Scherer, K. R., & Moors, A. (2019). The emotion process: Event appraisal and component differentiation. *Annual Review of Psychology*, 70(1), 719–745. <https://doi.org/10.1146/annurev-psych-122216-011854>
- Schmeichel, B. J., Volokhov, R. N., & Demaree, H. A. (2008). Working memory capacity and the self-regulation of emotional expression and experience. *Journal of Personality and Social Psychology*, 95, 1526–1540. <https://doi.org/10.1037/a0013345>
- Shenhav, A., Musslick, S., Lieder, F., Kool, W., Griffiths, T. L., Cohen, J. D., & Botvinick, M. M. (2017). Toward a rational and mechanistic account of mental effort. *Annual Review of Neuroscience*, 40, 99–124. <https://doi.org/10.1146/annurev-neuro-072116-031526>
- Slooman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin*, 119(1), 3–22. <https://doi.org/10.1037/0033-2909.119.1.3>
- Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences*, 23(5), 645–665. <https://doi.org/10.1017/S0140525x00003435>
- Thompson, V. A. (2009). Dual-process theories: A metacognitive perspective. In J. S. B. T. Evans & K. Frankish (Eds.), *In two minds: Dual processes and beyond* (pp. 171–196). Oxford, England: Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199230167.003.0008>
- Thompson, V. A., Evans, J. S. B. T., & Campbell, J. I. D. (2013). Matching bias on the selection task: It's fast and feels good. *Thinking and Reasoning*, 19(3-4), 431–452. <https://doi.org/10.1080/13546783.2013.820220>
- Thompson, V. A., & Johnson, S. (2014). Conflict, metacognition, and analytic thinking. *Thinking & Reasoning*, 20, 215–244. <https://doi.org/10.1080/13546783.2013.869763>
- Thompson, V. A., & Morsanyi, K. (2012). Analytic thinking : Do you feel like it? *Mind & Society*, 11(1), 93–105. <https://doi.org/10.1007/s11299-012-0100-6>
- Thompson, V. A., Pennycook, G., Trippas, D., & Evans, J. S. B. T. (2018). Do smart people have better intuitions? *Journal of Experimental Psychology: General*, 147(7), 945–961. <https://doi.org/10.1037/xge0000457>
- Thompson, V. A., Prowse Turner, J. A., & Pennycook, G. (2011). Intuition, reason, and metacognition. *Cognitive Psychology*, 63(3), 107–140. <https://doi.org/10.1016/j.cogpsych.2011.06.001>
- Topolinski, S., Likowski, K. U., Weyers, P., & Strack, F. (2009). The face of fluency: Semantic coherence automatically elicits a specific pattern of facial muscle reactions. *Cognition and Emotion*, 23(2), 260–271. <https://doi.org/10.1080/02699930801994112>
- Touroutoglou, A., & Efklides, A. (2010). Cognitive interruption as an object of metacognitive monitoring: Feeling of difficulty and surprise. In A. Efklides & P. Misailidi (Eds.), *Trends and prospects in metacognition research* (pp. 171–208). Boston, MA: Springer US. https://doi.org/10.1007/978-1-4419-6546-2_9
- Trippas, D., Handley, S. J., Verde, M. F., & Morsanyi, K. (2016). Logic brightens my day: Evidence for implicit sensitivity to logical validity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 42(9), 1448–1457. <https://doi.org/10.1037/xlm0000248>
- Vadeboncoeur, I., & Markovits, H. (1999). The effect of instructions and information retrieval on accepting the premises in a conditional reasoning task. *Thinking & Reasoning*, 5(2), 97–113. <https://doi.org/10.1080/135467899394011>
- VanLehn, K., Siler, S., Murray, C., Yamauchi, T., & Baggett, W. B. (2003). Why Do Only Some Events Cause Learning During Human Tutoring? *Cognition and Instruction*, 21(3), 209–249. https://doi.org/10.1207/S1532690XCI2103_01
- van Lieshout, L. L. F., de Lange, F. P., & Cools, R. (2021). Uncertainty increases curiosity, but decreases happiness. *Scientific Reports*, 11(1), 1–10. <https://doi.org/10.1038/s41598-021-93464-6>
- Vogl, E., Pekrun, R., Murayama, K., Loderer, K., & Schubert, S. (2019). Surprise, curiosity, and confusion promote knowledge exploration: Evidence for robust effects of epistemic emotions. *Frontiers in Psychology*, 10, 2474. <https://www.frontiersin.org/article/10.3389/fpsyg.2019.02474>
- Yeager, D. S., & Dweck, C. S. (2012). Mindsets that promote resilience: When students believe that personal characteristics can be developed. *Educational Psychologist*, 47(4), 302–314. <https://doi.org/10.1080/00461520.2012.722805>

Zerna, J., Strobel, A., & Strobel, A. (2024). The role of need for cognition in well-being—Review and meta-analyses of associations and potentially underlying mechanisms. *Collabra: Psychology*, 10(1), 92885. <https://doi.org/10.1525/collabra.92885>