Yang, J. C. et al. (Eds.) (2017). Extended Summary Proceedings of the 25th International Conference on Computers in Education. New Zealand: Asia-Pacific Society for Computers in Education

Learning to Think Critically: Technologies for Debiasing

Jürgen BUDER
Leibniz-Institut für Wissensmedien, Tübingen, Germany
j.buder@iwm-tuebingen.de

1. Introduction

Critical thinking is hailed as a key 21st century skill, and is also a main ingredient of deeper learning approaches (Adams Becker et al., 2017; Buder & Hesse, 2016). Critical thinking encompasses the ability to think in a clear, rational, and open-minded manner that is well-informed by available evidence. Educational researchers have long discussed the importance of critical thinking, and they also argued that the necessary skill sets for critical thinking are teachable (Halpern, 1998).

However, the question is how well-equipped our brains are to successfully engage in critical thinking. In fact, psychological research strongly suggests that our natural ability to think clearly, rationally, and in an open-minded and well-informed manner is prone to several biases.

Based on the cognitive and social psychological literature, this paper lists some of the most important biases that hamper the development of critical thinking. Subsequently, some debiasing techniques will be reviewed. They lead to design features of digital technologies that can be used to implement debiasing techniques. The overall connections of elements in my argumentation are depicted in Figure 1.

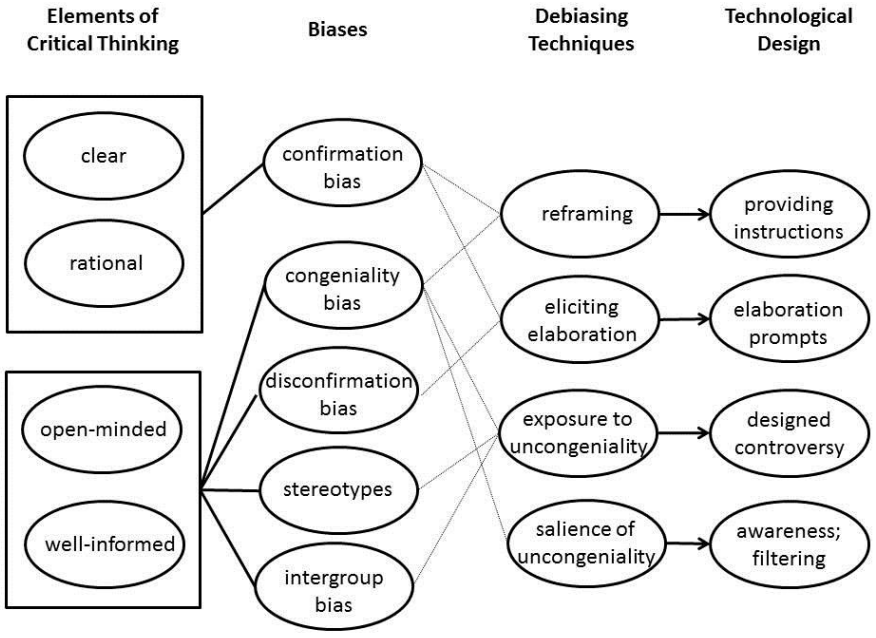

Figure 1. Elements of critical thinking, list of cognitive and motivational biases, list of debiasing techniques, and technological means to implement the techniques.

2. Evidence for Biased Information Processing

There is evidence that human information processing is prone to two general types of bias that I will refer to as cognitive biases and motivational biases. A cognitive bias refers to the tendency to engage in

faulty reasoning in the absence of any particular motivation to do so. Nickerson (1998) discusses cognitive biases at some length, and concluded that human information processing overwhelmingly is guided by confirmatory processing (confirmation bias). Of particular importance to critical thinking are difficulties that learners have in the proper testing of hypotheses, a task that requires clear and rational thinking (e.g., testing the rule "If a card has a vowel on one side then it has an even number on the opposite side" by selecting from a set of cards; Wason, 1966).

Moreover, human information processing is also colored by strong motivational biases (Kunda, 1990), which comes in two broad varieties. While people might be motivated to bias their information processing in order to achieve social approval (impression motivation), the most important motivation in the context of critical thinking is the tendency to prefer information that is consistent with an existing worldview, and to avoid or derogate uncongenial information (defense motivation). Defense motivation prevents an open-minded and well-informed view on a state of affairs. Based on the literature, I propose a distinction between four types of bias that can be related to defense motivation. First, there is a strong tendency to select congenial over uncongenial information, for instance in information seeking (congeniality bias; Hart et al., 2009). Second, while learners often scrutinize uncongenial information and seek for flaws in it (a sign of critical thinking), they fail to show a similar scrutiny with regard to congenial information which is often accepted at face value (disconfirmation bias; Buttliere & Buder, 2017). Third, information processing is often colored by the activation of stereotyped thought about persons (Greenwald et al., 2002). This can also introduce bias. And fourth, as people strongly identify with particular social groups, they also exhibit a tendency to favor their ingroup and/or derogate outgroup members (intergroup bias; Mackie & Smith, 1998).

3. Debiasing Techniques

From reviewing the literature, I propose four general classes of debiasing techniques. The first technique is *reframing*. For instance, framing the Wason card selection task in a social context can prompt non-confirmatory strategies of hypothesis testing. Moreover, the congeniality bias can be reduced by framing the importance of identifying a correct solution (Hart et al., 2009). A second technique involves *eliciting elaboration*. For instance, asking people to provide reasons for their attitudes makes people question their beliefs and is associated with more critical evaluation of congenial information (Wilson, Hodges, & LaFleur, 1995). Moreover, simple prompts like "consider the opposite" can have debiasing effects (Lord, Lepper, & Preston, 1984). The third technique is *exposure to uncongeniality*. Coming into contact with uncongenial information, meeting with outgroup members, or requesting learners to take a counter-attitudinal stance are known to reduce strong attitudes, stereotypic thinking, and intergroup bias (e.g., Pettigrew, 1998). Finally, the fourth technique is *enhancing the salience of uncongenial viewpoints*. This can be accomplished through a focus on uncongenial information of high quality (Hart et al., 2009), or through uncongenial social recommendations (Schwind, Buder, Cress, & Hesse, 2012).

4. Technological Design for Debiasing

All four debiasing techniques lead to considerations for technological design. First, reframing a task can be accomplished by the provision of instructions which can then engender debiased mindsets. Technological design should be informed by knowledge about the subtle effects that reframing can have on critical thinking. Second, elaboration of information can be elicited through situationally adapted prompts, or by reminding learners of the use of particular strategies (e.g., Berthold, Nückles & Renkl, 2007). Digital technologies are particularly suited to identify situations which would require the elicitation of prompts, for example via learning analytics. Third, digital environments can be designed to engender coming into contact with controversial viewpoints, for instance through two-sided representational formats (Hart et al., 2009). Alternatively, through proper selection of learning partners in a CSCL scenario it could be ensured that learners will come into contact with uncongenial viewpoints, thus fostering controversies. And fourth, there are strategies to make uncongenial information more salient. One of these strategies is to request learners to rate their discussion contributions on an agreement dimension, and visualizing discussion posts via a group awareness tool

(Buder, Schwind, Rudat, & Bodemer (2015). Another strategy that has been shown to improve critical thinking is to recommend preference-inconsistent rather than preference-consistent information in a recommender system (Schwind et al., 2012).

5. Concluding Remark

Critical thinking is a key skill not only for many learning contexts, but also in a broader sense of becoming an informed citizen. However, in order to become adept at critical thinking learners need to overcome some cognitive and social biases. Psychological research has identified a number of biases, but also pointed at several ways how biases can be counteracted. Through proper technological design, debiasing strategies can be implemented, thus helping learners to act in a clear, rational, open-minded and well-informed manner that has been the hallmark of critical thinking.

Acknowledgements

Research presented in this paper was funded by the Leibniz-WissenschaftsCampus "Cognitive Interfaces" in Tübingen, Germany.

References

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Hall Giesinger, C., & Ananthanarayanan, V. (2017). *NMC horizon report: 2017 higher education edition*. Austin, Texas: The New Media Consortium.

Berthold, K., Nückles, M., & Renkl, A. (2007). Do learning protocols support learning strategies and outcomes? The role of cognitive and metacognitive prompts. *Learning and Instruction, 17*, 564-577.

Buder, J., & Hesse, F. W. (2016). Designing digital technologies for deeper learning. In M. Spector, B. B. Lockee & M. Childress (Eds.), *Learning, design, and technology: An international compendium of theory, research, practice, and policy*. New York: Springer.

Buder, J., Schwind, C., Rudat, A., & Bodemer, D. (2015). Selective reading of large online forum discussions: The impact of rating visualizations on navigation and learning. *Computers in Human Behavior, 44*, 191-201

Buttliere, B., & Buder, J. (2017). Reading more vs. writing back: Situation affordances drive reactions to conflicting information on the internet. *Computers in Human Behavior, 74*, 330-336.

Greenwald, A. G., Banaji, M. R., Rudman, L. A., Farnham, S. D., Nosek, B. A., & Mellott, D. S. (2002). A unified theory of implicit attitudes, stereotypes, self-esteem, and self-concept. *Psychological Review, 109*, 3-25.

Halpern, D. F. (1998). Teaching critical thinking for transfer across domains. *American Psychologist, 53*, 449-455.

Hart, W., Albarracín, D., Eagly, A. H., Brechan, I., Lindberg, M. J.; & Merrill, L. (2009). Feeling validated versus being correct: A meta-analysis of selective exposure to information. *Psychological Bulletin, 135*, 555-588.

Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin, 108*, 480-498.

Lord, C. G., Lepper, M. R., & Preston, E. (1984). Considering the opposite: A corrective strategy for social judgment. *Journal of Personality and Social Psychology, 47*, 1231-1243.

Mackie, D. M., & Smith, E. R. (1998). Intergroup relations: Insights from a theoretically integrative approach. *Psychological Review, 105*, 499-529.

Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of General Psychology, 2*, 175-220.

Pettigrew, T. F. (1998). Intergroup contact theory. *Annual Review of Psychology, 49*, 65-85.

Schwind, C., Buder, J., Cress, U., & Hesse, F. W. (2012). Preference-inconsistent recommendations: An effective approach for reducing confirmation bias and stimulating divergent thinking? *Computers & Education, 58*, 787-796.

Wason, P. C. (1966). Reasoning. In B. M. Foss (Ed.), *New horizons in psychology I*, Harmondsworth, Middlesex, England: Penguin.

Wilson, T. D., Hodges, S. D., & LaFleur, S. J. (1995). Effects of introspecting about reasons: Inferring attitudes from accessible thoughts. *Journal of Personality and Social Psychology, 69*, 16-28.