Commentary on:

Conviction Narrative Theory: A Theory of Choice Under Radical Uncertainty. *Behavioral and Brain Sciences* **(forthcoming).**

1. **The name of the author(s) of the target article**
   Samuel G. B. Johnson, Avri Bilovich & David Tuckett

2. **Four separate word counts (abstract, main text, references, entire text (total + addresses etc.)**
   Word count abstract: 57
   Word count main text: 820
   Word count references: 187
   Word count entire text:

3. **An indexable and informative commentary title**
   Embodied choices bypass narratives under radical uncertainty

4. **Full name(s)**
   Rouwen Cañal-Bruland[a] & Markus Raab[b,c]

5. **Institution**
   [a]Friedrich Schiller University Jena, Germany
   [b]German Sport University Cologne, Germany
   [c]London South Bank University, UK

6. **Full institutional affiliation(s) (including Country)**
   [a]Department for the Psychology of Human Movement and Sport, Friedrich Schiller University Jena, Germany
   [b]Department of Performance Psychology, Institute of Psychology, German Sport University Cologne, Germany
   [b]School of Applied Sciences, London South Bank University, UK

7. **One email address each**
   rouwen.canal.bruland@uni-jena.de
   raab@dshs-koeln.de

8. **One home page url each (where available)**
   Rouwen Cañal-Bruland: https://www.spowi.uni-jena.de/en/departments/department-for-the-psychology-of-human-movement-and-sport/people/rouwen-canal-bruland
   Markus Raab: https://fis.dshs-koeln.de/portal/en/persons/markus-raab(05e809e4-1be0-45aa-b811-58adc6779693).html

9. **60 word abstract (57 words)**

   Johnson et al. suggest that we rely on narratives to make choices under radical uncertainty. We argue that in its current version CNT does not account for embodied, direct sensorimotor influences on choices under radical uncertainty that may bypass narratives, particularly in highly time constrained situations. We therefore suggest to extend CNT by an embodied choice perspective.

10. **1000 word main text (with paragraphs separated by full blank lines, not tab indents)**

Johnson et al. suggest that Conviction Narrative Theory (CNT) explains choices under radical uncertainty, arguing that we rely on *narratives* to make decisions. While we agree with many aspects of CNT and claims made in this target article, including the suggested relationship with boundedly rational approaches, we argue that CNT needs to be extended to account for direct sensorimotor influences and hence embodied choices that generate and inform decisions. More specifically, we challenge the proposition that "narratives characterize real-world decisions under radical uncertainty" (Table 2). In our view, this proposition is not generalizable because narratives do not include embodied choices defined as choices in which the sensorimotor system itself generates and informs decisions (Raab, 2017). Embracing an embodied choices perspective may become particularly relevant if CNT also aims at explaining and predicting motor choices and decisions that are made on rather short time scales.

To start with, narratives are defined as "structured, higher-order mental representations" that serve to "explain the past, […] predict the future, and evaluate possible futures". We do not dispute that CNT may account for a plethora of real-world decisions under radical uncertainty, such as for the chosen empirical examples regarding macro- and microeconomic decision-making. However, CNT relies on the assumption that narratives serve to first make decisions and then effectuate those decisions by means of actions. In other words, CNT can be classified as a classical 'first decide, then act'-theory (Gordon et al., 2021; Wispinski et al., 2020). Again, this classical approach may be valid for decision-making in economic decision-making under radical uncertainty, yet it falls short to explain many choices "our brains evolved to deal with", namely "embodied decisions" (Gordon et al., 2021, p. 722).

First, embodied decisions include many decisions in daily life that are made during continuous movements that are characterized by constantly changing action dynamics. Such changes in bodily action dynamics have been shown to directly influence decisions-making (Grießbach et al., 2021). It seems questionable whether such effects can be explained by narratives as the representational "currency of thought". For instance, Jax and Rosenbaum (2007) found uneconomic (or perhaps cognitively irrational) motor behaviors in reaching tasks. They explained their findings by arguing that participants faced the problem to trade two incommensurate currencies, namely motor programming and planning costs (and associated cognitive and neural resources) and biomechanical costs, referred to as "apples and oranges". It follows that by not accounting for the influence of sensorimotor information and embodied choices, CNT may fall short to explain at least some real-world decisions under radical uncertainty.

Second, data from the external world need to be perceived in order to inform narratives. Similar to embodied decisions there is evidence to suggest that perception is embodied (Lepora & Pezzulo, 2015). For example, Proffitt (2006) reviewed evidence corroborating that the perception of the environment changes depending on anticipated action costs, thereby adding to our critique that CNT is lacking an embodied perspective to explain choices under radical uncertainty.

Third, next to the emerging fields of embodied decisions and embodied perception, there is growing awareness that bounded rationality and heuristics are embodied (Gigerenzer, 2021). For instance, motor heuristics have been defined as simple rules of thumb that allow actors to motorically choose between options that satisfy the current demands of a given task or situation (Raab, 2017). In contrast to the examples chosen to support CNT, however, whenever movements are part of the action response, it is not only important what to choose but how the body constraints choices when exact movements in time and space matter such as when driving a car, crossing a street or playing sports.

Together, research on embodied decision, embodied perception as well as embodied choices point to the need to extend CNT in order to account for the embodied nature of choices under radical uncertainty. In our view, this is likely to be particularly important for explaining choices in highly time-constrained situations such as in fastball sports. Reflecting on the representations and processes in CNT illustrated in Figure 2, we are skeptical that such elaborate, sequential steps are run through, for instance, when a batter chooses when and where to move the bat in order to hit the ball into the outfield. We argue that it is much more likely that such choices bypass narratives to allow for successful movement solutions under high temporal demands.

In concluding their target article, Johnson et al. raise the possibility that there may be other forms of information they may not have considered. Here, we suggested that CNT would benefit from an embodied choice perspective that does not take motor actions as the mere executor of cognitive decisions, but acknowledges that changing action dynamics are generating and informing embodied choices. If such an embodied choice perspective would be embraced, CNT may also account for highly time constrained situations which by definition reflect choice under radical uncertainty, thereby allowing to generalize CNT to a broader set of real-world decisions.

13. Conflicts of Interest statement

Conflicts of Interest. None.

14. Alphabetical reference list (APA standard)

Gigerenzer, G. (2021). Embodied Heuristics. *Frontiers in Psychology, 12*, 711289.

Gordon, J., Maselli, A., Lancia, G. L., Thiery, T., Cisek, P. & Pezzulo, G. (2021). The road towards understanding embodied decisions. *Neuroscience & Biobehavioral Reviews, 131*, 722-736.

Grießbach, E., Incagli, F., Herbort, O. & Cañal-Bruland, R. (2021). Body dynamics of gait affect value-based decisions. *Scientific Reports, 11*, 11894.

Jax, S. A. & Rosenbaum, D. A. (2007). Hand path priming in manual obstacle avoidance: Evidence that the dorsal stream does not only control visually guided actions in real time. *Journal of Experimental Psychology: Human Perception and Performance, 33*, 425-441.

Lepora, N. F. & Pezzulo, G. (2015). Embodied choice: How action influences perceptual decision making. *PLoS Computational Biology, 11*, e1004110.

Proffitt, D. R. (2006). Embodied perception and the economy of action. *Perspectives on Psychological Science, 1*, 110-122.

Raab, M. (2017). Motor Heuristics and Embodied Choices: How to Choose and Act. *Current Opinion in Psychology, 16*, 34-37.

Wispinski, N. J., Gallivan, J. P. & Chapman, C. S. (2020). Models, movements, and minds: bridging the gap between decision making and action. *Annals of the New York Academy of Sciences, 1464*(1), 30-51.