

Peer-review report of

Nack, C. & Yu-Chin, C. (2023). Cognitive flexibility and stability at the task-set level: A dual-dimension framework. *advances.in/psychology*, 1(1), 1-28.

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Round 1

Dear Authors,

Thank you for your submission to *advances.in/psychology*. I independently read the manuscript before reviewing the detailed and constructive evaluations provided by two internationally esteemed experts, to whom I extend my gratitude. We all read your manuscript with great interest and recognize the importance of your contribution to the field of cognitive psychology and beyond. The paper presents a nuanced and well-balanced review of the literature, and the implications of the proposed model are wide-reaching. Reviewer 2 has recommended acceptance of the manuscript, having seen its evolution from a previous submission. Reviewer 1 suggests revisions. On this basis, I invite you to submit a revised version of the manuscript. There are many compelling elements within your paper, yet there is room for enhancement to fully realize its potential.

Reviewer 1 has offered a detailed critique, proposing various ways to improve the paper's structure to increase its persuasiveness to various audiences. They further recommend the addition of roadmaps at the beginning of the manuscript (at an overarching level) and at the start of each section to better prepare the reader for the content that follows. This approach is likely to make the paper that is relatively dense more accessible. The reviewer also requests that you make the connections between different parts of the discussion more explicit and to engage with more recent literature that supports the unidimensional model. I see this as important especially in light of the fact that some of the work was published before the replication crisis. I concur that Figure 1 should be removed and that Figure 2 requires elaboration to communicate the model's intricacies to a broad and expert audience effectively as it currently is too general.

Reviewer 2 advises against the use of acronyms (LWPC, LWSP) and provides overarching comments for your consideration. These comments, which are not mandated by the reviewer for revision, nonetheless offer valuable insights. They encourage you to explore the contested idea that stability and flexibility operate at the same cognitive level and the role of task order, which may reflect different temporal levels. The reviewer also calls for a deeper reflection on the empirical support for both the unidimensional and the dual-dimension frameworks, considering to what extent the evidence is correlational or if it allows for causal (e.g., transfer) inferences.

Additionally, I would ask you to address a few minor points for clarity and consistency:

- Please use "and" instead of "&" when referring to two authors in text; e.g., Dreisbach and Goschke (2004).
- There is a missing word on page 14, line 1: the sentence should likely read "asking participants ABOUT."
- Please avoid the use of contractions such as "won't" or "don't," for example, as seen on pages 21 and 22.

In conclusion, your manuscript is already strong, but by considering the reviewers' suggestions, particularly those relating to presentation, it has the potential to become even stronger. When submitting your revised manuscript, please include a letter detailing the changes you have implemented or providing rebuttals for any points you dispute.

Warm regards,

Jonas R. Kunst

Editor-in-Chief

Reviewer 1

Overall, this manuscript presents an interesting perspective, supported by the authors' review of relevant literature, that flexibility and stability related to metacontrol may be better conceived of as representing independent dimensions rather than alternative facets of a unidimensional structure. Thus, I believe the work has the potential to attract substantial scholarly attention. The work is scholarly, insightful, and promising. However, I found the current version of the manuscript a bit diffuse, making the argument and its implications less persuasive than it could be. Thus, I recommend that the authors be invited to revise the manuscript. I think the raw material is already in the current version, but I believe that a tighter organization, involving some restructuring and re-emphasis is needed to make the argument more compelling. There are many ways that could be accomplished, but I offer some recommendations about some ways that this could be accomplished.

In general, I felt that the structure, in terms of high-level headings (e.g., The Unidimensional Framework of Flexibility and Stability) are appropriate and ordered in a logical way. Most of my recommendations pertain to the internal organizations of these sections. One common theme is that it would be valuable to explain at the beginning of each section the main objective of the section and to outline the arguments and information that will be presented, explaining the rationale behind the organization. Another frequent request I have is to present the material in a more detailed and conceptually deeper way. The authors commendably try to make the work accessible to a broad audience through examples and illustration. However, it is also important to speak to and inform those with more expertise in the topic. For example, I would prefer to see a more elaborated conceptual model in the Figures rather than the more very basic illustrations represented currently in Figure 1 and 2.

Those invested in this topic are likely to be the primary audience of the work, and greater emphasis on the theoretical advances it offer would likely be more appealing. Below I offer comments and suggestions for each section.

1. *Introduction.* In general, while I found the example of the student helpful, I think it would be valuable to condense it a bit to get to the main scientific issue being considered faster. Then, I recommend moving up the definitions of the core concepts of flexibility and stability (p. 3, line 1) to immediately after the terms are first introduced in the main text (p. 2, line 24). After that, to highlight the main objective of the current work more, I recommend beginning a new paragraph with a new sentence or two documenting that these concepts have been studied with a unidimensional framework and explaining the objectives of the present research and their theoretical significance. For example, the key point, which is not made until later in the Introduction (p. 5, line 24), that “According to the unidimensional framework, flexibility and stability are considered 24 antagonistic, always varying inversely” comes too late in my opinion and should be foregrounded more. In general, I found the structure of the abstract clearer than the first few pages of the Introduction, which meanders a bit. While the material is generally well written, it is not organized in a way that makes a compelling case for the new contribution of the current work. I do believe that the current approach and analysis are valuable; my concern is that case is not presented soon and persuasively enough in the current version of the manuscript.

2. *The Unidimensional Framework of Flexibility and Stability.* Once that big picture – the current unidimensional view and the conceptual case for what a dual dimensional framework offers – is more fully developed in the Introduction, I agree that the next step, as this section does, is to summarize the unidimensional perspective and what is viewed as support for it. I think it would be helpful to the begin this section with an advance-organizer paragraph, laying out (perhaps as subsections) the main elements. Following somewhat the current organization of this section, I suggest the authors present, in order, the unidimensional framework (see p. 6, l. 7 ff), the rationale, the ways it is tested (e.g., the information currently in the manuscript about paradigms used to examine flexibility and stability), and the evidence taken as in support of this position. The information is basically already reported in this section, but I think the presentation would be stronger if readers could follow a clear roadmap through it. Also, the authors’ current argument relies on a relatively detailed explanation of the Dreisbach and Goschke (2004), followed by a list of other studies (p. 7, l. 23 ff) that document a flexibility-stability trade-off. Given the age of the Dreisbach and Goschke study and the fact that the current work is arguing about the need for a new direction for research in this area, I believe that it is important that the description of the empirical foundation underlying the unidimensional perspective be expanded with a more detailed review of the works listed on p. 7, l. 23 ff. When arguing again an established position, I believe that it is important to present that position fully and in a way that provides reader with a good understanding of the empirical support that the position currently enjoys. This review

might also prepare readers for the critique that follows, for example by calling attention to inconsistent or incomplete findings.

3. *Challenges to the Unidimensional Framework.* Again, I think an advance - organizer paragraph that describes the organization of the elements (possibly subsections) and the rationale behind the order would greatly strengthen the manuscript. Beyond the details presented, readers would benefit more from the big picture. Some advance organizing occurs later in this section (see p. 9, l. 25 ff); my recommendation is that the roadmap be presented, with the underlying rationale, at the beginning of the section. This section should highlight the limitations, loose-ends, or inconsistent evidence of the unidimensional approach.

4. *The Alternative Dual-Dimension Framework (DFF).* This section might begin by explaining what issues the DFF mainly addresses and what new value it adds. I also recommend that a more extensive theoretical grounding of the DFF be developed. Essentially, the framework is presented heuristically in Figure 1 and 2. While it is useful to make an argument about how a framework fits existing data, a more persuasive theoretical case needs a stronger connection to theory. In particular, can an *a priori* case be made about why it is possible and even likely that flexibility and stability are separable factors? This would make the manuscript more compelling and to me represents an important issue for further consideration in the revised manuscript. For instance, are the neuroscience or other types of data that at least suggest that stability and flexibility are conceptually independent and implicate the role of context? Then, the section might focus on the application of the DFF to current data. How does the DFF framework explain current findings that purport to support the unidimensional position? It would be helpful to walk readers through the expanded evidence in the section on the current state of research. Then, it would be valuable to walk readers through how the DFF addresses the specific challenges to the unidimensional approach considered in the earlier section.

5. *Discussion.* I suggest here that the authors begin the section by stating its goals and then outlining the content of the section. In terms of the text itself, the paragraphs need more “connective tissue.” The points made are interesting and stimulating, but the paragraphs are quite discrete – I had a hard time discerning the flow of where the work was going. Stylistically, beginning with an advance-organizing paragraph would help, but also thinking more about a conceptual integration of the various points made should yield a substantive improvement.

In conclusion, this is a stimulating manuscript with considerable promise. There is a core of a very strong manuscript here. However, I feel that the manuscript needs further refinement and would benefit from deeper theoretical treatment of some pivotal issues. The authors clearly have mastery over the relevant literature, and I believe that they will be able to make the appropriate changes to strengthen the work. Thus, as I noted at the outset, I recommend that they be given the opportunity to revise the manuscript for further consideration for publication.

Reviewer 2

I have reviewed this paper before, and have seen it going through substantial revisions already. While I still have doubts about the utility of this new framework (see below), I do believe it is a valid perspective to have. Moreover, it starts from the interesting and correct observation that a too simplistic view of the stability/flexibility trade-off is insufficient in explaining the current empirical evidence. I am not aware of other recent papers that spelled out this observation with such detail, which makes it a noteworthy contribution to the literature. As mentioned, I do not think that the perspective presented here is the best way forward, but also think this should not be a reason for rejection. Instead, I hope this paper will be published and made available for discussion in the broader literature.

Minor:

- When citing studies about contextual manipulations of switch frequency: Crump et al. (2006) and King et al. (2012) are about congruency, not switch frequency.
- I would not introduce the abbreviations LWPC and LWSP for readability.

For completeness and future reference (as I believe this journal makes the reviews available as well), I would still like to summarize some of my main thoughts below, but do not necessarily expect the authors to discuss them in this paper (unless they would like to):

I am not sure whether the claim is justified that his tradeoff is being discussed “within a single level of cognition”, as now mentioned in the manuscript. The time points and processing stage at which the here-discussed measures of “stability” and “flexibility” impact performance can differ. The act of switching between tasks usually precedes the act of shielding a task from distractions (i.e., after the task goal has been set/determined). This way, someone efficient at “metacontrol” (i.e., deciding when to be flexible and deciding when to be stable) can be both flexible and stable at nearby points in time (or at different levels of information processing). Put differently, I believe arguments can be made for the idea that setting a task goal (and the stability versus flexibility with which one maintains it versus switches to a new one) occurs at a different level of processing than performing that task (where different levels of stability versus flexibility in stimulus perception and response selection can also be defined within the context of that task). I believe this is particularly the case for the reviewed studies where the interference around which stability is measured does not come from another (recently relevant) task, but comes from a generally irrelevant, distracting stimulus (e.g., a flanker, irrelevant word meaning, or visual distractor in an attentional capture paradigm). It seems not too surprising that dealing with these kinds of distractions does not relate much to modulations in switch costs or task-rule congruency effects (which relate more to the balancing and representating of currently or recently relevant tasks sets). Much of the empirical evidence for the dual dimension framework is also correlational, or involves the lack of transfer between the training of a cognitive flexibility task and a conflict task. The fact that these tasks

do not correlate or transfer fits well with the general idea that cognitive control is so context-sensitive, as the authors also emphasized. I find it more difficult to see it as hard evidence against the usefulness of thinking about a flexibility-stability continuum when having to switch back and forth between two tasks or, separately, when having to consider focusing on a task in the face of tempting distractions. Both, I believe, can also be redescribed as separate flexibility-stability problems in different contexts or different moments in time. Finally, on a semantic level, it remains unclear to me what defines “rigidity” and how it should be dissociated from “stability”. In terms of the mental processes that these terms are supposed to describe, rigidity in task switching can still be considered stability of some sorts. Similarly, “distractibility” during task performance can still be considered a “flexibility” of some sorts. Whether or not it is adaptive depends on the context. Instead, the dual-dimension framework now seems to describe two dimensions where there is always an optimal side of the continuum, and a suboptimal one (with rigidity and distractibility having the more negative connotation). Whereas the unidimensional view introduced this trade-off to describe certain features of mental processes, this dual-dimension view seems to repurpose these terms (stability and flexibility) as evaluations of performance, which I fear might be less ideal for theory-building.