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Review of Patrycja Kalamala's doctoral dissertation: *Language Experiences and Cognitive Control-Assessment and Interactions*

This is a magnificent doctoral thesis. It consists of three published studies, each of which addresses a different aspect of cognitive control. The first two studies directly address the consequences of bilingual language experience and the third study examines conflict resolution on a trial-level time frame. The use of language games in the second study is a creative and highly innovative approach to this topic. The theoretical frame of the thesis is Green and Abutalebi's (2013) Adaptive Control Hypothesis. The idea is that the demands on cognitive resources that are imposed by the way that the bilingual's two languages are used, will have consequences more generally for how cognitive control is achieved. There are some remarkable strengths in the three published studies. The work that is reported exploits sophisticated analytic approaches that do not make simplistic apriori assumptions about the measures used. To the contrary, this is research that challenges claims in the previous literature by taking a much closer look at the methods themselves.

The thesis adopts an impressive range of tools to ask how the evidence for the consequences of language adapation for cognitive control aligns across contexts of language use and across different measures of cognitive control. Three aspects of this approach are particularly notable. One is that it is grounded in the cognitive and cognitive neuroscience literature on cognitive control. Much of the past research on the consequences of bilingual experience has made connection to this substantial literature but has not represented it as centrally as in these papers. This itself, in my view, is a major contribution. Much of the field still assumes that research on bilingualism is a boutique topic with few implications for understanding fundamental cognitive mechanisms. The controvery surrounding the bilingual advantage has been interpreted by many in that light. The present thesis demonstrates the centrality of language experience for the mechanisms that enable domain general cognitive control. A second notable feature of this work is that it compares behavioral findings to the neural signatures observed in brain activity measured by EEG. Like many past studies on language processing, there are dissociations between what we see in the behavioral data and what is revealed by brain activity. In the second experiment that appeared in *Bilingualism: Language and Cognition*, there is a dissociation between the behavioral and ERP data, suggesting that it is not code switching itself that is critical but the use of both languages in the same context. In the third experiment that appeared in *Cortex*, focused only on the cognitive mechanisms that operate within trial, there is also a dissociation, leading to different claims about whether different aspects of cognitive control are independent of one another. The third notable aspect of this program of research is that it assumes that the mechanisms under investigation are complex, both with respect to language and with respect to the contributions to cognitive control. Much of the controversy that has arisen about bilingualism and language experience more generally, can be understood as a failure to recognize that the regularity of complex mechanisms can be examined if one adopts tools that are senitive to that regularity.

I have a number of comments but would like to frame them by what I have said already – this is an enormously impressive body of research for a doctoral thesis, the papers have appeared in top venues, and they hold the promise of having high impact and implications not only for understanding particular phenomena but also for how we frame the research questions from the start.

From the perspective of language experience and language processing, there are three issues in the present work that I think might deserve a bit more attention and discussion. First, and most critically, particularly with respect to the predictions of the Adapative Control Hypothesis, it seems important to recognize that all of the participants in the first two studies were native Polish speakers in their L1 environment, all of whom were relatively late bilinguals, having acquired English as the L2 after the earliest years of childhood. We might debate what is early or late, but the critical issue is that the majority if not all of the Polish-English bilinguals in this study were living in a context where, regardless of whether they code switch, there was little in the way of requirements to monitor the language in use. Polish-English university students are surrounded by other Polish-English university students. Some of the past studies that have demonstrated support for the predictions of the Adaptive Control Hypothesis, have shown that it is not code switching per se that is critical but rather the level of uncertainty and decision making imposed by the context of language use (e.g., Beatty-Martinez et al., 2020; and see Zhang et al., 2021 that appeared following the submission of this thesis). In the present work, there is little uncertainty imposed on these bilingual participants. These other studies suggest that when bilinguals are immersed in an L2 environment in which there is uncertainty about which language may be spoken and with whom, we are more likely to see the active engagement of control mechanisms, in the case of the two papers I've cited, proactive control. Each of those studies examined bilinguals like the Polish-English bilinguals in the present studies who were living immersed in their L1 (in one case Spanish-English bilinguals and in the other, Mandarin-English bilinguals). In each case, they did not find the same results in the L1 context.

A second issue concerns the control or regulation of language vs domain general cognitive control. The Adaptive Control Hypothesis is focused on the role of the context in imposing demands on cognitive resources but how those cognitive resources may be engaged to solve language problems may differ from how those resources are changed themselves. The three papers in this thesis are focused on the domain general mechanisms but not on the language processes themselves. I believe that we need to be modest at this phase of the research in making claims about how language is regulated relative to cognition, but the emerging evidence seems to suggest that language regulation itself taps into overlapping aspects of the cognitive control network, making them related but not identical. Without addressing the issue of language regulation/control, I think it is premature to suggest that the first experiment in particular serves to refute the predictions of the Adaptive Control Hypothesis.

A third issue is about time. A fascinating aspect of this thesis is that the different studies address cognitive consequences over differ time frames. And indeed, the controversy about the consequences of bilingualism has largely been a controversy about the long term consequences of using two languages activity across individual's lives. The comparison of EEG data and behavior provides a neat way of examining the immediate consequences and early indices of control. But in addition to needing a theoretical framework for relating the language processes

referred to above to the domain general cognitive control mechanisms, we also need a principled basis on which we might generate predictions for not only what the consequences might be but also for when and how they emerge. For example, the work of Pliatsikas (2020) examining structural changes in the brain, suggests that we need to take a developmental approach to understanding how adaptions emerge and change dynamically. We might imagine an analogous approach that includes the within-trial adapations to understand not only which aspects of cognitve control are affected but how the timeframe over which they appear (or disappear) inform claims about the consequences of language use more generally. We know very little at this stage of research about which changes endure and which are ephemeral but a more deliberate focus on the time course of both language and cognitive control seems important for us to have a comprehensive understanding of the phenomena under investigation.

There is much to discuss and much to anticipate as new findings emerge. It has been a pleasure to read this thesis. I am confident that it will serve as an important basis in the agenda for this next stage of research.
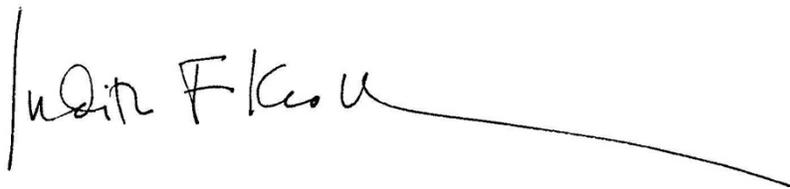
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