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Dissertation Review

„How mood influences native and non-native language processing: Behavioural and electrophysiological evidence“

by Marcin Naranowicz, MA

Marcin Naranowicz presents a dissertation addressing a so far little studied topic, namely the extent to which and the mechanisms of how experimentally induced mood-states influence language processing in one's first (L1) or second (L2) language. Previous work has addressed mood-effects on L1 processing, mostly on the sentence level, and there is of course a large literature on bilingualism in general, but the two aspects have rarely been combined. Also, the dissertation combines behavioral and electrophysiology work which is commendable as electrophysiology provides more fine-grained information on mental chronometry than behavioral studies alone do. Formally, the dissertation consists of four papers that have already been published. A first behavioral study has been published in the *Journal of Biligualism*, as second study, combining electrophysiology and behavioral data was published in *Brain Sciences*, a third study, with a focus on electrophysiology, was published in *Brain and Language*, and a fourth theoretical review article appeared in *Frontiers in Psychology*. The PhD candidate is the second author in the study published in Brain and Language (but the detailed contributions state equal contribution with the first author) and he is the sole author of the final study. Studies 1 and 2 are multi-author studies with Marcin Naranowicz as the first author.

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Considering the work in more detail, Study 1) combined positive and negative mood inductions via short film clips (which were also used in the other studies) with an evaluative judgement task on positive, negative, and neutral single words and studied 28 males and 28 females (although 10 participants were later excluded as non-responders to the manipulation). Overall, faster reaction times were found for positive than negative words which were in turn responded to faster than neutral words. Also, L1 words were responded to faster than L2 words and there was an interaction in that mood affected reaction times on positive, negative, and neutral words differently in L1 and L2. Positive mood accelerated responses to neutral words more in L1 than in L2, whereas it accelerated responses to positive words more in L2 than in L1, so that L2 positive words reached the same response speed as in L1. In L1, there was no such differential effect of mood for positive words, although overall fastest reactions were observed for positive L1 words in a positive mood. As evidenced by Figure 4 of this manuscript, these effects are quite substantial with separation of confidence intervals (although effect-sizes are not indicated).

Although self-reported mood varied with mood induction in both male and female participants, overall mood effects on task performance were found only in females. Only in females were reaction times generally faster in the positive than in the negative mood.

In sum manuscript 1 reports on an interesting phenomenon, is well-powered and is commendable in its transparent data presentation. It is also well-written, as is the entire dissertation. It is a pity that the gender distribution of non-responders to the mood manipulation is not reported (unless I am overlooking it), as it could provide further evidence regarding differential mood-sensitivity in males and in females. As currently reported, my impression is that on a self-report level both genders are equally sensitive to mood induction (Figure 1 a and b), but that they seem to differ in the effects this has on a further

cognitive task. The author takes the findings to suggest that females might be more susceptible to mood fluctuations than males (e.g. Bianchin and Angrilli 2012). While this may be the case, my impression is that this does not strictly follow from the present data. What does seem supported is that mood affects some aspects of language processing more in females than in males.
At any rate, as correctly pointed out by the author, both mood modulations of language processing and gender effects clearly deserve further scientific attention.

With the subsequent experiments, the author provides some of this scientific attention, however focusing more on the mood-modulation aspect of things and incorporating the findings about gender primarily in that in the further studies only females were included as participants. This is an understandable and legitimate decision, also since I suspect that in an English language department, like in a typical psychology department, recruitment of females will be easier than recruitment of males. However, in general, scientists need to pay attention to behavioral science not becoming too much the science about well-educated young females (see the WEIRD people discussion).

In study 2 Marcin Naranowicz also expands the analysis level from single words to whole sentences, adding electrophysiology as a level of analysis, and employing a typical N400 design (semantic appropriateness judgement) in L1 and L2. This change of design is probably at least partly motivated by the author's group's experience that L1/L2 differences in emotional language processing are often more clearly seen on the sentence level, although effects were observed on the word level in study 1 of this dissertation. In this second experiment of the thesis, 30 females made semantic decisions on emotionally neutral Polish or English sentences, following either positive or negative mood inductions. The experiment

employed a within-participants design with mood-inductions serving as a repeated-measurement variable. In general, the experiment uses very well controlled and described stimuli and procedures. It also employs a very reasonable approach in that it focuses on emotionally neutral sentences first. Moreover, timely and rather complex statistical methods are used, particularly for the behavioral data. As expected, mood manipulations were successful and participants' behavioral responses were highly accurate in both languages (>95%), with meaningless sentences being identified as such even more often in the negative mood. Electrophysiological data regarding processing of the critical sentence final word revealed a number of interesting effects already on very early components, with higher P1 to L2 sentence-final words and also higher P1 in positive mood. Likewise, for the N1, English (L2) sentences elicited larger sentence-final N1 in positive than in negative mood which was not the case in Polish (L1). Further, the fronto-central N2 was larger for positive than negative mood in L1, but not in L2. Remarkably, these findings reveal differential mood effects on L1/L2 language processing already on relatively early perceptual and lexical processing stages. From a sentence processing point of view perhaps most interesting are effects on "classical language components", namely N400 and LPC: Here, the classic N400 effect was attenuated to insignificance in a positive mood in L1, whereas this was not the case in L2, or in either language in a negative mood. For the LPC, in negative mood, a larger "reprocessing" effect was found in L2 than in L1. In positive mood no such differentiation was present. With this experiment, the author provides a very comprehensive data analysis which demonstrates that mood effects on language processing can start already at the perceptual stage and can further differ between languages, even within the same participants. In this regard, the within design clearly pays off. Effects are generally quite sizeable, as evidenced by the provided effect sizes. On the other hand, the many behavioral and

electrophysiological results make it challenging to discuss them within a coherent framework. The author generally lived-up well to this task (perhaps with the exception of a slight repetitiveness regarding description of results) and thereby demonstrated how well-read he is in his research area. As an aside, it is unclear to me, why the interpretation of the present results (as well as others in this dissertation) requires appeal to active emotion regulation and inhibition. Doing without those might be more parsimonious overall, especially since the paradigm used is not a typical inhibition or regulation paradigm.

The third and last empirical study addresses how positive and negative mood states impact processing of neutral, “creative”, and anomalous sentences in L1 or L2. This study likewise focused on females and used ERPs (N400 and LPC) in a semantic decision task as dependent measures. The obtained behavioral data served mostly as a general engagement check, since the critical word this time was presented at a mid-sentence position, resulting in less immediate behavioral responses. The L1/L2 contrast was realized as a between design and 47 useable datasets remained in the Polish (N=24) or English (N=23) language session. The use of novel creative sentences (“novel metaphors”), which might be seen as falling somewhere between literal/affectively neutral and meaningless sentences, presents the major novelty in this design and on theoretical grounds, one could expect those to be particularly susceptible to mood manipulations. In particular, one might expect that in a positive mood these sentences are integrated more easily (ERPs more similar to literal meanings) than in a negative mood state (more similar to meaningless sentences, higher N400 and potentially also LPC). Differences between L1 and L2 seem a little harder to predict. Indeed, Marcin Naranowicz and his co-first author propose that mood effects should be restricted to L1, similar to study 2. As a first result of study 3, on a self-report level, mood induction is only

successful for negative, but not for positive mood. Regarding ERPs, the study reports an N400 effect with both anomalous sentences and “novel metaphors” deviating from standard meaningful sentences without difference between mood states or languages. In the LPC window, by contrast “novel metaphors” patterned with literal meaningful sentences following positive mood induction, differing from meaningless sentences (which might suggest that the positive mood induction did have an effect at least on the neural level). In negative mood, the three sentence types did not differ at all in average ERP amplitudes and again there was no difference between L1 and L2. This is per se a very interesting pattern regarding the temporal order of meaning assimilation and the effects of mood on this process. What is a little surprising, is that the L1/L2 differences observed in study 2 were not replicated which might have been expected given that the material likewise consisted of neutral sentences. On the other hand, there were some important differences between the studies regarding placement of the critical word, power (within versus between design) and context (presence of “novel metaphors”) the influence of which should be further discussed orally. Thus, study 3 demonstrates mood-dependent effects on the integration of unusual, but per-se semantically acceptable, meanings, with positive mood broadening the neural acceptability lens which would be in line with other studies demonstrating similar phenomena in L1.

Overall, this set of studies reveals partly interactive effects of mood and language status on behavioral and electrophysiological indices of word and sentence processing, thereby breaking ground in a so far little researched area. The area is important, given that mood states provide a pervasive background tone to all mental activity and given that multilingualism is turning into the norm rather than the exception. In general, while each of the studies reveals interesting and important findings, and while they are clearly highly novel, one concern could

be the generalizability and replicability of the findings. Whereas sample sizes are good and statistical reporting up to date and transparent, the studies, while all on mood effects on language processing in female students, also show quite some variability in methodological detail. On the one hand, this gives the author the opportunity to demonstrate his skills across various aspects of his topic. On the other hand, it also makes it hard to gauge which of the results would hold up on direct replication or with only minimal variation in method. They may well all be directly replicable, but given that there is so little internal replication in the presented data, this is hard to predict.

While only future research will be able to settle this question, the theoretical paper provided as the fourth manuscript of the dissertation greatly helps to further contextualize the findings and to provide a coherent picture of what typical patterns in the field of mood and language processing are. Interestingly (and appropriately) reproducibility is one aspect that is addressed in this theory paper. This chapter also allows the reader to demonstrate his writing skills and his independence as a young scientist and his knowledge of broader theoretical approaches. It covers a multitude of approaches, is generally well structured and written (although I am not 100% sure I understand what "ethically-minded methodological aspects of experimental mood elicitation" are) and communicates the reviewed science efficiently, so that it will be useful to other researchers in this field and likely also contribute to its growth as providing a structure typically helps growing a field.

All in all, I agree with Marcin Naranowicz in his conclusion that the findings from his dissertation "offer novel insights into research on affect and bilingualism, demonstrating that whether a bilingual person is in a positive or a negative mood determines how well they comprehend their respective languages." I also agree that "further

research is still needed to better understand potential modulatory factors of such mood–language interactions, including gender and individual differences in bilinguals' linguistic profiles." In this sense, the dissertation helps define a research area whose internal structure and mechanisms will have to be specified further. At the same time, the presented works provide strong motivation and guidance for other researchers to do so.

Clearly, formally and quantitatively, the presented PhD thesis fulfills the criteria and expectations for a successful dissertation. It covers a relatively new topic, utilizes up-to-date methodological approaches and provides evidence for the author's ability to work in a research team as well as to contribute independently his own position and perspective. **Therefore, I recommend acceptance of the submitted dissertation.**

Regarding the question whether the presented work merits further distinction, I feel some ambiguity. I do think that Marcin Naranowicz is to be complimented for the wealth of valuable data that he and his group produced and he clearly helps put a new research segment on the map, which is more than most PhD students and dissertations can claim for themselves. At the same time, as stated before, the research strategy has a bit of a "probing for various novel phenomena" flavor to it, which makes it harder to identify the underlying mechanisms of "how mood influences native and non-native language processing" as advertised in the introduction. Given that the novelty aspect contained in this dissertation is quite high, though, I recommend leaving the question of whether the present work should be awarded a further distinction, to be decided after the oral defense, depending on whether pending issues can be clarified.

I hope this evaluation will be helpful for the PhD committee.

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Sincerely,