Using Signal Detection Theory to Investigate the Role of Visual Information in Performance Monitoring in Typing

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outcome (hence their categorization as external-channel models by our definition), effectively calculate conflict between predicted and sensory inputs within the same layer of the language processing system (Guenther, 2016). In short, the notion of conflict can be used more broadly to capture something essential about monitoring: regardless of the specific mechanism, the predictions of all the monitoring

In two experiments, we ha [illegible] words they heard under a temporal dea [illegible] ine (word-feedback) condition, they saw [illegible] the screen in real time. In the no-feedba [illegible] ord did not appear on the screen until th [illegible] ith the goal of understanding the poter [illegible] monitoring performance as a function o [illegible] nformation. Based on prior results, we ex [illegible] ion rates in the no-feedback compared to [illegible] condition (Pinet & Nozari, 2020). The n [illegible] Exp 1 was adding a question right after [illegible] icipants if they had made an error or not [illegible] ment; Fig. 2), as an independent measur [illegible] s. Exp 2 aimed to replicate the findings [illegible] er probe the specific role of visual info [illegible] ng. We added a new condition (posi [illegible] which participants saw dots (instead o [illegible] yped, similar to masked password typing [illegible] This condition still provided visual i [illegible] e *position* of the letters, but not their *id* [illegible] distinguish between the role of these tw [illegible] information for monitoring.

The data from both experiments were c [illegible] Misses, Correct Rejections, and False Alarms (se [illegible] definitions) and were analyzed by SDT models [illegible] estimated d' and criterion parameters for each subject. Group analyses compared these parameters across conditions. A decrease in d' indexes the loss of information that cleanly teases apart the distributions of correct and error trials, and thus tells us about the necessity of certain kind of

Results & Discussion

One participant was excluded for failure to follow task instructions. The error rate in the no-feedback condition was lower than the word-feedback condition (21.2±10.3% vs.

the other hand, were higher in the no-feedback compared to the word-
= 29.7, t = 16.8, p <.001). The same was true for IKIs

Figure 3 shows the SDT measures for monitoring indices.

The overall rate of error awareness (hit rate) in metacognitive judgments was 69% and 54% in the word-feedback and no-feedback conditions, respectively. Model-estimated *d′* was significantly lower for the no-feedback compared to word-feedback condition (2.1 ± 0.4 vs. 2.9 ±
-.81, t = -7.0, p <.001), whereas the location of the criterion did not significantly differ between the two

The overall rate of correction attempts (hit rate) was 28% (763 attempts) in the word-feedback and 8% (221 attempts) in the no-feedback conditions. Model-estimated *d′* was significantly lower for the no-feedback compared to word-

correction rates. In both cases, this was indexed by a lower d' when visual information was removed. This finding shows that the overall error signal can be successfully modeled as a combination of internal and external channels, and that the removal of the external channel manifests as increased noise (i.e., closer distributions) in SDT terms.

Participants, however, treated the reduced quality of information differently when making metacognitive judgments about performance vs. when attempting corrections. They only shifted their criterion for a decision in the latter case to avoid False Alarms, because of the cost associated with attempting corrections for an already correct response. This finding shows that although, generally speaking, the same kind of information (broadly defined as conflict) underlies both metacognitive judgments and corrections, (implicit) decisions about how to use such information is task-dependent.

Teasing apart the contribution of positional information from letter identity revealed that positional information alone had a small but significant effect in enhancing corrections; d' increased when participants could keep track of where they were in the word without seeing the letters, as in password typing. Inspection of the criterion also showed that having access to positional information increased participants confidence in aiming for higher Hits, potentially accepting a higher risk of False Alarms.

To summarize, this study demonstrated the utility of SDT in investigating different outcomes of monitoring (error awareness and corrections) in a framework that combined information from internal and external channels, regardless of specific mechanisms. Despite the mechanistic differences postulated in models of language monitoring, our approach allows for drawing general conclusions about the underlying processes, that could then be integrated into, and further investigated within, a specific framework. In particular, this application revealed important commonalities between tasks, i.e., reliance on generally similar information, as well as differences, i.e., different strategies for dealing with the change in information quality. Finally, the framework was useful in hierarchically investigating the finer-grained contributions of specific kinds of information in the visual signal. These results serve two purposes: they shed light on the importance of external information for monitoring performance, especially for applying repairs, and at the same time show the promise of SDT in furthering our understanding of how information from various sources are combined, and how participants handle the partial loss of information in various tasks that depend on monitoring. Given the individual-fitting of the model, this approach is also particularly promising for the analysis of individual differences in monitoring, and monitoring-related functions.

References

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