"Well, that wasn't so bad!": Comparing forecasted and retrospective ratings of affect in the context of automated driving

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Affect is a transient emotional state that has both a positive and negative valence (Watson, Clark, & Tellegen, 1988). Positive affect (PA) is related to things such as excitement and arousal (Watson et al., 1988). Negative affect (NA) is related to things such as fear, sadness, and frustration (Watson et al., 1988). The Positive and Negative Affect Schedule (PANAS) was developed to measure self-reported positive and negative affective states in the present or past (Watson et al., 1988). PANAS has been adapted for forecasting affect, or estimating how one would likely feel in relation to an anticipated situation (Calderwood, Green, Joy-Gaba, & Moloney, 2016; Noah, Gable, Schuett, & Walker, 2016). People tend to *overestimate* the NA that they expect to experience in a given situation, when compared to their reported affect during the situation (Calderwood et al., 2016). Forecasting affect has also been used to determine how different driving environments (highway, rural, urban, and suburban) could impact feelings towards automated safety features and driving systems (Noah et al., 2016).

The goal of the present study was to determine how forecasted PA and NA compared to post-experience affect, in the automated driving context. Forecasted affect is particularly important in this context, as it could be a barrier to acceptance of automated vehicles. If people anticipate negative feelings from driving an automated vehicle, they may choose to avoid that technology.

Here, 62 participants completed a forecasting PANAS prior to interacting with an automated vehicle simulation. They were to imagine driving a vehicle and using an automated lane keeping system (ALK; a system that controls lateral lane position), when responding to the items. Participants then drove a 7-8 minute simulated drive (*baseline drive*) using ALK, after which they completed a (retrospective) PANAS assessing the drive they just completed. Participants then completed an approximately 15-minute drive (*failure drive*), also with ALK. During this drive, there was an automation failure (ALK system turned off), from which participants had to recover and continue to drive manually. Participants completed the last PANAS after the *failure drive*, with instructions to refer to the drive they just completed when responding to the items.

We hypothesized that PANAS timing (*forecasted*, after *baseline drive*, and after *failure drive*) would impact both positive and negative affect scores. Specifically, we hypothesized that there would be a significant change in both PA and NA scores, in reference to the *forecasted* and the post-*baseline drive* and post-*failure drive* measurements.

Results from this study, seen in Figure 1, showed that there were significant main effects of timing (forecasted, baseline drive, failure drive) for both PA, $F(1.486, 4.459) = 8.997$, $p = .001$, $n_p^2 = 0.134$, and NA, $F(1.742, 5.525) = 37.554$, $p < .001$, $n_p^2 = 0.393$. Follow-up paired t-tests for both PA and NA used the Bonferroni corrected alpha of $p=.0167$. There was no significant difference between the *forecasted* PA and the *baseline drive* PA, which indicates initially experiencing a neutral (normally functioning) automated driving system was congruent with participants' expectations. After experiencing an automation failure in the *failure drive*, participants' PA was significantly reduced, in comparison to the forecasted PA, $t(61) = 3.451$, $p = .001$. There was also a reduction in PA between the baseline and failure drives, $t(61) = 2.583$, $p = .012$. This shows that even after an initial neutral interaction with the automation, the automation failure greatly impacted PA.

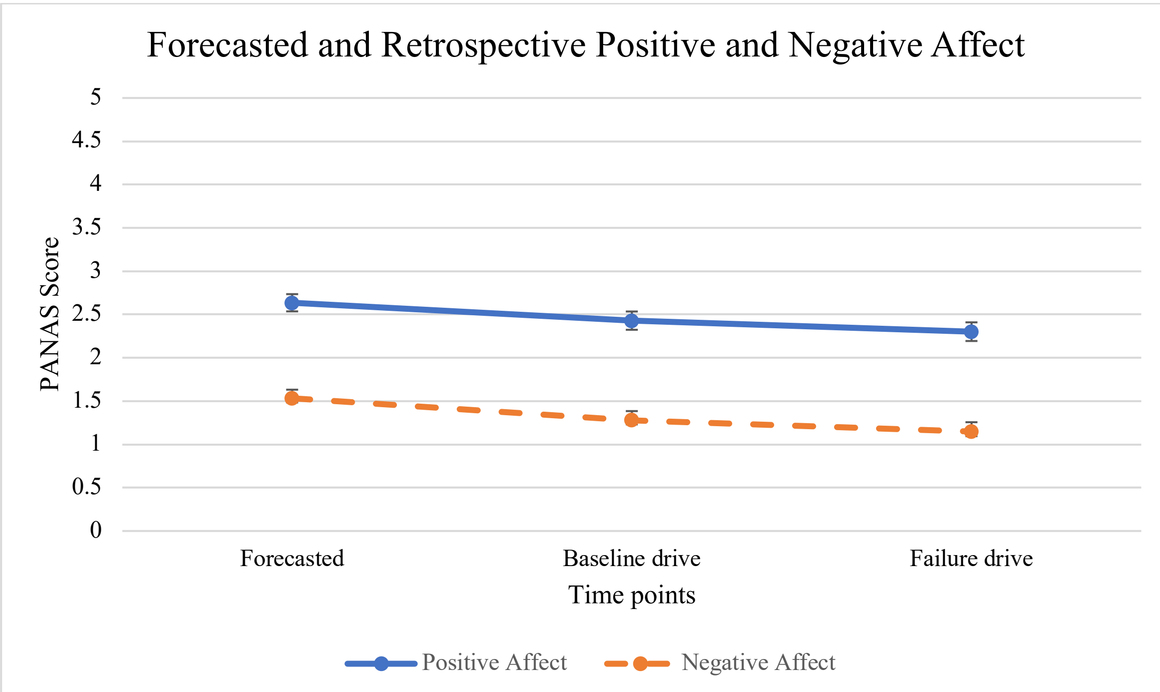

Figure 1. Mean positive affect (PA) and negative affect (NA) scores over three time points.

There was a different, but also interesting, pattern of results for the NA. The forecasted NA was significantly greater (i.e., more negative) than what was reported after the *baseline drive*, $t(61) = 5.658$, $p < .001$. That is, participants felt less negative about the automation after they experienced it. Most interestingly, there was a further reduction in NA between the *baseline* and *failure* drives, $t(61) = 3.435$, $p = 0.001$ (and also between the forecasted and *failure drive* scores, $t(61) = 7.243$, $p < .001$). Even though participants had a negative experience with the automation, their resulting level of NA was nevertheless diminished. The root of this result is a substantial over-estimation of the forecasted NA. After the first (neutral) experience, participants seem to have realized automated driving was not as bad as initially expected. These negative feelings were further reduced by experiencing the automation failure. This pattern of results is similar to previous research where students overestimated their NA with multimedia sources being removed from a homework task (Calderwood et al., 2016).

The results of this extend previous results to the automated driving domain showing that, fundamentally, people tend to overestimate the negative feelings they will have with a technology or situation prior to experiencing it. These results highlight the importance of experiences with automated vehicles in shaping our feelings towards them. Future work should explore how initially negative interactions may impact feelings about automated systems over time.

References

Calderwood, C., Green, J. D., Joy-Gaba, J. A., & Moloney, J. M. (2016). Forecasting errors in student media multitasking during homework completion. *Computers & Education*, *94*(2016), 37–48. https://doi.org/10.1016/j.compedu.2015.10.021

Noah, B. E., Gable, T. M., Schuett, J. H., & Walker, B. N. (2016). Forecasted affect towards automated and warning safety features. In *AutomotiveUI 2016 - 8th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, Adjunct Proceedings*. https://doi.org/10.1145/3004323.3004337

Watson, D., Clark, L. A., & Tellegen, A. (1988). Positive and Negative Affect Schedule. *Development and Validation of Brief Measures of Positive and Negative Affect: The PANAS Scales*, *54*(6), 1063–1070.