

Investigating the Effect of *doppel* on Alertness

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Abstract: This study assessed the effect of *doppel*, a wearable device developed by Team Turquoise Ltd that delivers tactile stimulation on the wrist. In particular, the main interest was on whether the use of *doppel* would enhance alertness. During the Psychomotor Vigilance Task (PVT) that measures sustained attention the use of *doppel* reduced the percentage of lapses, indicating an increased ability to sustain attention. Importantly, this effect was independent of the order of presentation of conditions, suggesting that *doppel's* contribution was specific, rather than a general effect. Overall, the observed results suggest that *doppel* use may have a tangible effect on behavioral performance as well as subjective experience during task performance.

1. Introduction

The aim of the present study was to assess the effect of *doppel*, a wearable device developed by Team Turquoise Ltd. that aims to help people manage the pressures of time and stress in their daily lives. *doppel* is an on-demand, discrete, user-controlled, heartbeat-like vibration applied through a wristband. In the final product, the wrist band is connected via Bluetooth to a smart phone app where the user measures their resting heart rate and chooses their preferred up and down stimuli. The anticipated goal of the product is to use this effect to enable the user to control how they feel and perform. In particular, the study assessed the effects that *doppel* use has on alertness as measured behaviorally and on subjective reports of arousal and valence.

2. Methods

Participants

Forty participants (29 female, mean age 20.6 years, age range 18 to 31) gave their informed consent to participate in this study that was approved by the Departmental Ethics Committee, Department of Psychology, Royal Holloway, University of London. Participants were reimbursed 7.50 GBP for their participation. The study was carried out at the Lab of Action and Body, Department of Psychology, Royal Holloway, University of London.

Participants were informed that the study focused on how tactile stimulation on wrist that may or may not simulate a heartbeat influences our alertness and mood. Participants were asked to wear a band on their wrist (i.e.a prototype of *doppel*, see image below) while they completed the Psychomotor Vigilance

Task, sustained-attention, reaction-timed task that measures the speed with which subjects respond to a visual stimulus.



Design

The experimental design consisted of two conditions. Across both conditions, participants were asked to wear a prototype of the *doppel* wearable band. In the critical test condition, *doppel* delivered tactile stimulation at a frequency of 100-120bpm, while in the control condition *doppel* did not deliver any tactile stimulation, even though it was still worn by the participants. The order of presentation of the two conditions was counterbalanced across participants. Across both condition, participants completed the Psychomotor Vigilance Task (PVT; Houghton & Wilkinson, 1982).

The PVT is a simple task where the subject presses a button as soon as the light appears. Participants were instructed that their task was to press a key as fast as possible as soon as the light appeared on the screen. On each trial, the light appeared randomly between 1 and 9 seconds. Sixty trials were administered for each condition, resulting in a total of 120 trials (Loh et al, 2004). Trials for which reaction time was faster than 150ms were excluded from analysis. Trials for which reaction time was slower than 500ms were classified as lapses. Trials for which reaction time fell between 150 and 500ms were classified as correct trials. As the purpose of the PVT is to measure sustained attention, the percentage of lapses (i.e. how many times the button is not pressed within 500msec from the

appearance of the light) is more informative than mean reaction time (Houghton & Wilkinson, 1982; Dinges & Powell, 1985). The results section provides analyses for both dependent variables.

At the end of each condition, participants were asked to rate their arousal and valance on 1-9 Likert scale using the Self-Assessment Manikin (Bradley & Lang, 1994). The Self-Assessment Manikin (SAM) is a non-verbal pictorial assessment technique that directly measures the pleasure and arousal associated with a person's affective reaction to a wide variety of stimuli.

3.Results

We first focused on the percentage of lapses which is the dependent variable of interest. Mean % of lapses were submitted in a mixed ANOVA with the factor Condition (*doppel* vs control) as within-subjects and the factor Order of Presentation (*doppel* first vs control first) as between-subjects factor. Only the main effect of Condition was significant ($F(1,38)=3.16$, $p<0.05$, 1-tailed, see Figure 2). Participants committed fewer lapses in the *doppel* condition compared to the control condition, irrespectively of the order of presentation, indicating that during the *doppel* condition participants were more alert.

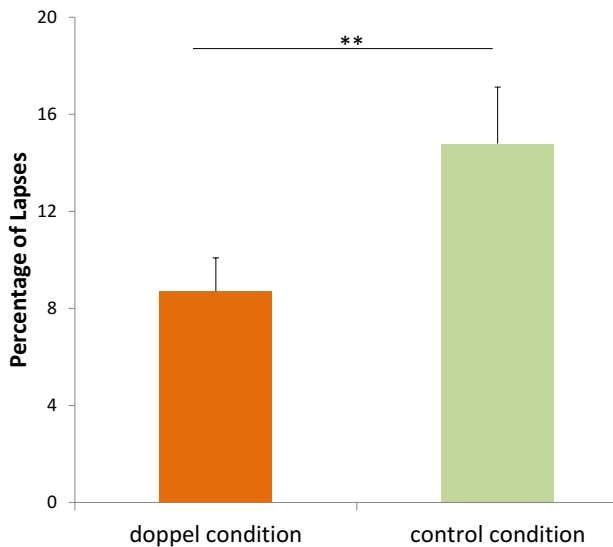


Figure 1 : Percentage of Lapses (error bars are S.E.M.)

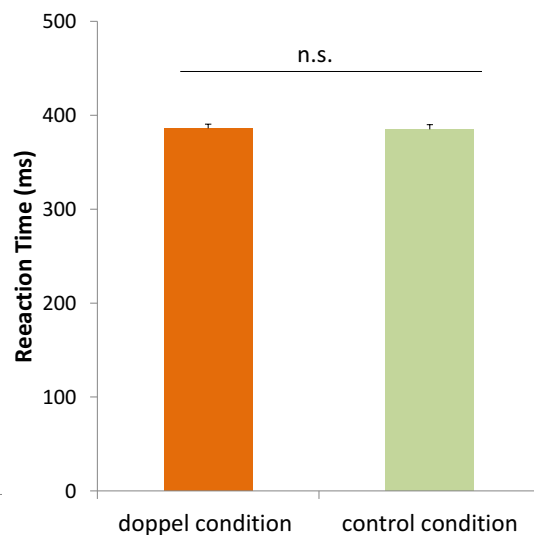


Figure 2 : Mean Reaction Time (error bars are S.E.M.)

We next focused on Reaction Time (RT). Mean RT per condition were submitted in a mixed ANOVA with the factor Condition (*doppel* vs control) as within-subjects and the factor Order of Presentation (*doppel* first vs control first) as between-subjects factor. None of the main effects of condition or order of presentation of conditions were significant (all $p>0.05$; see Figure 1). The interaction between Condition and Order of Presentation was significant ($F(1, 38)=8.9$, $p=.005$). This interaction was driven by the fact that order of presentation affected performance at the control condition, with reaction time being faster when the control condition was presented first.

Valence ratings were submitted in a mixed ANOVA with the factor Condition (*doppel* vs control) as within-subjects and the factor Order of Presentation (*doppel* first vs control first) as between-subjects factor. None of the main effects of interaction were significant.

Arousal ratings were submitted in a mixed ANOVA with the factor Condition (*doppel* vs control) as within-subjects and the factor Order of Presentation (*doppel* first vs control first) as between-subjects factor. The only significant finding was a main effect of condition as participants reported higher arousal

following the *doppel* condition as compared to the control condition ($F(1,38)= 26.0, p<0.001$; see Figure 3).

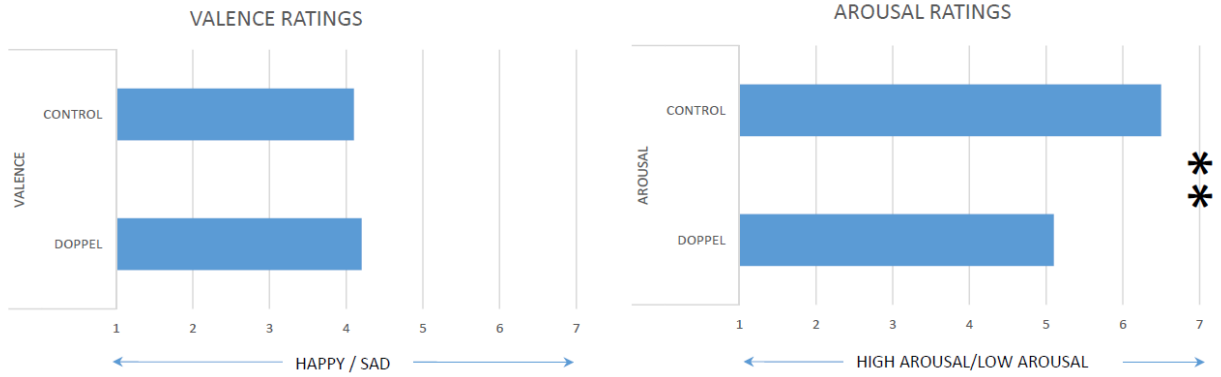


Figure 3: Mean Valence and Arousal Ratings

We next investigated the correlations between our dependent measures. Only the correlation between Valence Ratings and Reaction Time in the *Doppel* Condition was significant $r=.63, p<0.001$, suggesting that people who reported more positive valence at the *doppel* condition also performed faster at the PVL task (see Figure 4).

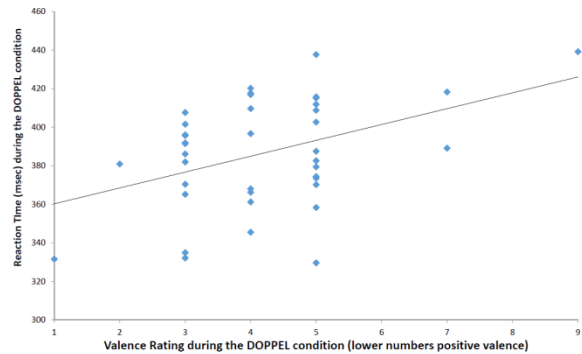


Figure 4: Positive Correlation between Valence Ratings and Reaction Time in the DOPPEL condition

4. Discussion

This study assessed the effect of *doppel*, a wearable device developed by Team Turquoise Ltd that delivers tactile stimulation on the wrist. In particular, the main interest was on whether the use of *doppel* would enhance alertness, as measured by the number of lapses that participants had. To that end, an established psychomotor task that measures sustained attention, the Psychomotor Vigilance Task (PVT), was used. Because the primary aim of the PVT is to measure sustained attention, lapses (i.e. trials where participants' attention was not sustained) are more informative than simple reaction time. The key finding was that the use of *doppel* reduces the percentage of lapses, indicating an increased ability to sustain attention. Importantly, this effect was independent of the order of presentation of conditions, suggesting that *doppel's* contribution was specific, rather than a general effect. In addition, following the use of *doppel*, participants reported increased arousal, and the extent to which they reported more positive valence at the *doppel* condition was correlated with faster responses as measured with reaction time. Overall, the observed results suggest that *doppel* use may have a tangible effect on behavioral performance as well as subjective experience during task performance.

References

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