Human Electrodermal Response to Remote Human Monitoring: classification and analysis of response characteristics

By Paul Stevens

Abstract

This study reanalysed datasets from two past studies and attempted to identify some characteristics of human electrodermal reactions to remote monitoring by another human – an aspect of Direct Mental Interaction with Living Systems (DMILS) research. The objective was to see if an electrodermal DMILS response were similar to a sensory response and, if not, to see if there were any useful characteristics that could be used to identify the DMILS response. A second objective was to compare the electrodermal response seen in DMILS to that seen in reaction to a weak magnetic field, with the aim of starting to explore potential mechnisms or physiological response systems that might produce the observed DMILS effects.

No electrodermal activity was observed that could be easily identified as comparable to a sensory reponse and there was no evidence of a *consistent* difference between activate and calm periods. Consistent between-participant differences were noted when comparing DMILS responsiveness to resting electrodermal activity. Overall, a consistent scale-invariant pattern was found showing response-similarities between the type of influence periods: based on the variance of electrodermal activity, there were significant differences between any type of influence attempt and rest periods ($p<0.01$ and $p<0.0002$, both 2-tailed for the two DMILS datasets used). This pattern was also seen in the magnetic field exposure data, possibly indicating similarities between DMILS and magnetic response mechanisms.

Introduction

Recent years have seen a increase in the use of physiological, as opposed to conscious, responses to ostensibly psi-mediated stimuli. Such research, often used in studies into 'direct mental interaction between living systems' (DMILS), indicate that an individual's conscious response may not be a good measure of psi. Instead, a physiological reaction (often a measure of electrodermal activity, EDA) related to the stimuli is a more reliable indicator (e.g. Sah and Delanoy, 1994; Stevens, 1998). However, the DMILS research concentrating on physiological responses has tended to show an emphasis on using the responses purely as relative measures - the levels of physiological arousal in different conditions are compared to the mental intention (stare vs not stare, or calm vs arouse) of a remote person. There has been less research into the characteristics of response which is found - information which could offer insights into possible mechanisms or artefacts. There are also many papers on the subject which contain the implicit assumption that the electrodermal DMILS (EDA-DMILS) response might be akin to a sensory response - for example, Braud et al (1993) makes use of psychological profiles for physiological responses to sensory-stimulus to explain EDA-DMILS responses - but there appears to be little work looking for those characteristics in the electrodermal data.

In the bioelectromagnetics field, it is noted (Bell et al, 1992; Conner and Lovely, 1988) that many organisms have a high sensitivity to certain electromagnetic field characteristics, usually in the low frequency ranges which overlap biological activity (e.g. 0.5 - 30 Hz for global brain activity, 40 Hz thalamic-cortical loop, 100 Hz muscle activity). This has led some researchers (e.g. Popp et al, 1994 - biophoton emission by organisms; Ho et al, 1992 - electromagnetic synchronisation between organisms) to suggest that there may be an electromagnetic component to intercellular communication. If such communication does exist, then we might also expect a global response (based on the combined cellular response) in the human body in the presence of a suitable electromagnetic stimulus, Such a response would show up as a perturbation of physiological activity, and thus maybe also a behavioural change. An interesting question is therefore whether a DMILS responses might be related to some form of interorganism electromagnetic communication?

Previous studies by this researcher (Stevens, 2000) showed a global response to an applied, weak magnetic field (MF). Participants exposed to a randomly occurring, oscillating MF (50 microTesla at 20 Hz) exhibited an average 2% decrease in level and 64% decrease in variance of electrodermal activity. This effect was not due to any conscious awareness of the fields, or to external sensory cues. Affective perceptions were also perturbed during double-blind magnetic field exposure, with all images presented during field exposure being rated as more positive but less arousing than they were during control conditions. Compared to the typical EDA-DMILS response, this magnetic field response was around 5 to 10 times stronger, but this was probably due to the much greater strength of the artificial field when compared to those which could be generated by the human body: at best, the magnetic field of the latter is around 0.1 nanoTesla i.e. more than 100,000 times weaker. Although this difference in magnitude is large, there is limited experimental support for fields comparable to the human biomagnetic field also having measurable effects on human physiology and behaviour (e.g. Sandyk, 1992; Sandyk and Derpapas, 1994). So if the DMILS mechanism is associated with physiology-generated MFs, as other studies suggest (Stevens, 1998; Sah & Delanoy, 1994; Schwartz, 1974), then we might expect to find similar response characteristics in the recipient's physiological. Essentially EDA, and possibly also other response-measure, DMILS experiments may be seen as magnetic sensitivity experiments with a biological MF generator. By this, I mean that the physiological or behavioural responses seen in EDA-DMILS studies may relate to some form of electromagnetic interaction. This sort of explanation will be easier to apply to situations where the two participants are relatively close together, as greater separation distances bring up currently unanswerable questions as to the possible range of such weak stimuli: bioelectromagnetics research can offer no widely applicable

mechanism for weak magnetic field responses so there is little basis for speculation either way as to their potential for long-distance interactions. Note also that I am not advocating a return to the early 'mental radio' models that proposed encoded communication between individuals. Instead, I am suggesting that the presence of a biologically-generated magnetic field might have a significant effect on human physiology. An individual's interpretation of the effect will depend on a host of factors but not necessarily on the information content (if any) of that field.

Characterisation and comparison of physiological responses to remote human monitoring and to an artificially generated weak MF might allow clearer definition of the EDA-DMILS effect, leading to better experimental design and insights into possible mechanisms for DMILS effects as a whole. It would also provide a greater understanding of the role that MFs play in normal physiological functioning, helping to determine the action of electronic equipment (e.g. VDUs, fluorescent lighting, electric blankets) on humans. This would help clarify situations where shielding would be beneficial to humans working with MF generating equipment, and may also lead to better or novel therapeutic uses of such fields.

Electrodermal responses to sensory stimuli

For an electrodermal response to a sensory stimulus, a rapid increase shortly (1-5 seconds) after the stimulus onset would typically be expected, followed by a slower decrease (Cacioppo & Tassinary, 1990). In an experimental setting, this *phasic* response would be superimposed on a downwards trends (the *tonic* response) that indicated the percipient was getting more relaxed as the experiment progressed. Figure 1 shows an idealised form of this.

{Figure 1 about here}

If the EDA-DMILS response had a sensory component, we might then expect a similar, though probably weaker, electrodermal response to be seen.

Procedure

The data used were taken from existent physiological databases from two recent EDA-DMILS studies (Watt et al, 1999; Delanoy et al, 1999) and a magnetic sensitivity study conducted by the author (Stevens, 2000). All data were recorded from self-selected volunteer participants. Skin conductance (microSiemens) was recorded using 78.5 mm^2 Ag-AgCl round electrodes and either an isotonic electrode paste or a water-based cream (the latter was used in the magnetic sensitivity study), placed on the second phalanx of the index and second fingers of the non-dominant hand, and secured using a velcro strip. Hardware data reduction was via the Physiodata monitoring system, model I410 (J&J Engineering, Poulsbo, WA) which has a resolution of 0.24 microSiemens. This was interfaced to a high speed serial port on a 100 MHz Pentium PC. Data was sequentially sampled at 1024 Hz, and time-averaged samples saved to disk at 16 Hz. In the Stevens study, test runs were conducted to ensure that there was no detectable direct pick-up of the magnetic fields by the physiology leads.

For the EDA-DMILS studies, the data consisted of 'arousal', 'calm' and 'rest' (control) periods. Complete data was available for 43 participants in the Watt et al study, and 80 participants in the Delanoy et al study. For the magnetic sensitivity data, the data consists of 'magnetic exposure' vs. 'null exposure' (control) periods, and complete data was available for 29 participants. Both data-sets used fully randomised, double-blind presentation of experimental vs. control periods. All data analysis was conducted using Visual Numerics' PV-Wave numerical and graphical analysis programming environment.

One problem with measures of electrodermal activity is that different people will show very different ranges of activity, making between-participant comparisons difficult. To avoid this, the raw skin-conductance values are often transformed using some normalising technique. In this study, the raw values were transformed to z-scores i.e. expressed in units of the standard deviation (sigma, σ) of

each participant's skin-conductance values. This technique reportedly gives a useful and robust measure for subsequent analysis (Sersen et al, 1978). Thus, the n^{th} raw data point for participant i would become:

$$z_{n\,i} = \frac{x_{n\,i} - \bar{x}_i}{\sigma_i}$$

Additionally, when plotting graphs, the initial value for each condition has been defined as the origin, as it is the relative change in skin conductance values under each condition which is of interest.

Results

An attempt was thus made to characterise the electrodermal response seen for each condition (activate, rest and calm) in the 2 EDA-DMILS studies. Based on the expectations of sensory responses, each participant's data for the first 5 seconds of each experimental period was studied but no obvious response was visually evident. A few individuals did appear to occasionally exhibit an amplitude increase shortly after the presumed stimulus onset (i.e. the start of the influence period), but there was very little consistency, making it more likely that these represented spontaneous, non-specific responses. The possibility that there was a weak response which was lost in the noise was then investigated by combining the results of all participants in a study and plotting their average response profile. If there were a consistent but weak signal, this procedure should serve to amplify the consistent signal while the random noise would cancel out. The plots are shown in figures 2 and 3.

{figure 2 about here}

{figure 3 about here}

The Watt study could be showing a DMILS response, although it is a very flattened one if so. There is little to distinguish between activate and calm profiles, although there is a clear distinction between influence and rest periods. The Delanoy et al study is less clear: the activate period looks more like the expected profile for the rest period, and both rest and calm periods show what could be a possible response to a DMILS stimulus.

As there appeared to be no classic sensory-like response in the expected period, this could mean that the EDA-DMILS effect occurs in a more subtle manner, showing an effect over the full influence period. To investigate this possibility, the averaged data for all participants from the entire duration of an experimental period was studied. Plots of these data are shown in figures 4 and 5.

{Figure 4 about here}

{figure 5 about here}

As can be seen, there is considerable variation in electrodermal activity over the full period. The Watt study profiles still appears to show a fairly clear distinction between influence and rest periods, but the activate/calm periods are again hard to distinguish. The Delanoy et al study profiles become even more confused, although there is a suggestion of similar behaviour for the influence profiles, although the direction with respect to rest is in the opposite direction to that seen in the Watt study.

Given the lack of any clear response in the initial 5 seconds after stimulus onset, all of the following analyses refer to the whole epoch (20 or 30 seconds, depending on which study is being analysed).

The Watt et al study in detail

Table 1 shows the total number of individual's averaged skin-conductance responses in each direction (i.e. whether they were in the right or wrong direction with respect to the designated intention) for the Watt study. Activate periods seemed to show a better response rate, but calm periods were also more likely to show ***increased*** activity. Furthermore, within individual profiles, electrodermal activity for activate periods was higher than in calm periods in only 44% of cases. As the standard statistical measure used in EDA-DMILS is based on whether arouse periods show an increase

and calm periods show a decrease in skin conductance levels (i.e. the overall direction of the response) it is perhaps not surprising that past results have been sporadic.

{table 1 about here}

This lack of consistency could indicate that there is no effect. However, this would be contrary to the overall evidence that there is a difference between activate/calm periods and rest periods. Looking again at the average profile for the Watt et al study (figures 2 and 4) it is clear that the activate and calm periods show a consistent difference to the rest periods. An alternative approach would be to suggest that the DMILS stimulus was very weak so that the response was below the level of noise inherent in an individual's physiology. However, this does not account for past findings which show that physiologically labile people exhibit a stronger effect (Braud, 1994). Such people should be far less likely to respond to a weak stimulus as they essentially have more noise in the in their systems. A more likely possibility is that DMILS does not work in a way analogous to a conventional sensory response. That is, we are looking at a more basic form of interaction, or something possibly more akin to a direct influence.

The overall profile further suggests that the influence sessions (activate and calm) were more variable that the rest periods. This was tested by calculating the variance of each individual's skin conductance values from each epoch, then combing them to give overall averages for that individual for each of the three conditions. Figure 6 shows the results.

{figure 6 about here}

A Wilcoxon signed-ranks test comparing the variance of each individual's skin conductance values from each of the epochs (see Table 2) showed that all 3 conditions significantly varied from each other, with the greatest difference being between the Calm/Activate periods and the rest period.

{table 2 about here}

The Delanoy et al study in detail

Table 3 shows the direction of individual responses in the Delanoy et al study. This time, it was the calm periods which appeared to show the best response, with the activate periods more likely to show decreased activity. Within individual profiles, electrodermal activity for activate periods was higher than in calm periods in only 31% of cases (which accounts for this study failing to reach overall statistical significance based on a conventional EDA-DMILS analysis).

{table 3 about here}

Figure 7 shows the comparison of the mean variance for each individual's responses for each epoch. The profile is very similar to that seen in the Watt et al study (figure 6) even though the scales are different. This suggests that there is a consistent pattern in the variance of the EDA-DMILS responses across individuals.

{figure 7 about here}

A Wilcoxon signed-ranks test (see table 4) this time showed that both of the influence conditions significantly varied from the rest period, but not from each other. As the original study was non-significant based on the activate-calm mean-level comparison, this could indicate that a more robust future measure would be to look at this variability of electrodermal activity in influence periods compared to ***rest*** periods, rather than at the mean level.

{table 4 about here}

An interesting feature of the Delanoy et al study was that they also recorded electrodermal activity from the sender. This allows us to see whether (a) the sender was trying to influence the receiver during the correct periods (b) what kind of general strategies they were using and (c) whether there is any correspondence between their electrodermal activity and the receiver's. The averaged profiles for the initial 5 seconds and the full duration are shown in figures 8 and 9 respectively.

{figure 8 about here}

{figure 9 about here}

Interestingly, the senders' electrodermal activity is very similar irrespective of whether they are attempting to activate or to calm the receiver. This implies that they were using an active strategy i.e. getting worked up whilst trying to achieve their aims, rather than attempting to simulate the desired state in themselves as is often assumed.

Individual Profiles

Looking at the DMILS data-sets as a whole, it was noticed *post-hoc* that the individual profiles appeared to fall into 2 broad categories: low and high responders. The average electrodermal activity profiles for individuals in each of the groups showed similarities. Low responders had very flat profiles, with little change between rest, activate and calm periods. High responders were more variable, showing strong (though not necessarily consistent) differences between the conditions. This appeared to be true whether the data considered was for the initial 5 seconds (where we would expect a sensory response to occur) or over the full duration of each DMILS condition. Some typical examples of low and high responders in the 2 studies are shown in figure 10.

{figure 10 about here}

All the participants were then numerically classified as responders versus null-responders, depending on whether they exhibited any kind of response greater than the (arbitrary) value of 0.2 sigmas at any point after the start of the influence period. A Kolmogorov-Smirnov 2-sample test was used to compare the distributions of their *resting* physiological activity to see if they were significantly different (i.e. was the baseline physiological activity of responders different from null-responders). Results are given in Table 5.

{table 5 about here}

It appears that there was some *a priori* difference between those who showed a response and those who did not, the null responders having a lower variability to their resting physiological activity (i.e. they are less *labile*). This could be a trivial finding if all the physiological fluctuations were non-specific and not due to any kind of DMILS effect – in effect it shows that people who exhibit fluctuating physiology do so consistently. However, given that both of the original studies showed a significant difference in physiological activity between conditions (albeit in the wrong direction for the Delanoy et al study), it seems worthwhile to suggest that lability has a role to play in DMILS effects. For example, this could indicate that future studies would benefit from pre-selecting participants who had higher lability as these, if they showed a DMILS effect, would show a stronger response.

Note that there are some problems with this analysis in that the rest periods were interspersed with the influence periods - as such, they are not independent measures. A better measure would be to collect pre-experiment baseline physiological activity, using this to screen participants for further involvement. Note also that this analysis was based on visual inspection of a response in the averaged profiles. The null-responders may also include participants who showed weaker responses, so more research is needed to better define the 'labile' physiology.

Comparison with responses to magnetic fields

For the data from the magnetic sensitivity study, a sensory-like response was again looked for in the 5 seconds of each experimental period (note that the MF exposure periods, unlike the two DMILS studies, were only 5 seconds in length in total). As with the DMILS, no clear response of this type was found. The plot shown in figure 11 showed the overall averaged response profile. There does appear to be a slight depressing of the electrodermal activity during field exposure periods, which corresponds to the statistical analysis performed in the magnetic sensitivity study (Stevens, 2000) which indicated the mean level of electrodermal activity was lower during field exposure.

{figure 11 about here}

Figure 12 shows the result of calculating the mean variance for each individual's responses for MF and control exposure periods. Note that the profile is very similar to that seen in the two DMILS studies (equating MF with Activate, and Control with Rest).

{figure 12 about here}

A Wilcoxon signed-ranks test comparing the differences in variance (see Table 6) showed that the 2 conditions did not significantly vary from each other, although they were in the prespecified direction (note that in the MF study a unidirectional response was expected based on earlier work – see Stevens, 2000 for details). The non-significance could have been due to the lower number of participants used in the MF study.

{table 6 about here}

Discussion

The data from the first 5 seconds of each experimental period showed no clear response after the presumed onset of the DMILS 'stimulus'. Moreover, the combined results showed little to distinguish between conditions. There were clear differences within each of the two studies, but this was not consistent between studies. The data from the entire duration of an experimental period also shows considerable variation, but there was slightly more consistency between studies. The Watt et al study profiles still showed a distinction between influence and rest periods and the Delanoy et al study profiles showed a suggestion of similar behaviour, although in the opposite direction. Overall, it does not appear that DMILS works in a way analogous to a response to a sensory stimulus. Instead, it may represent a more basic form of interaction, possibly more akin to a direct influence (i.e. the original idea of biological psychokinesis). Another possibility is that the DMILS stimulus, if such exists, takes longer to be detected than the 5 second window used in the initial analysis allows. In some cases, this does appear to be the case as some individuals show a maximal difference between calm and arouse conditions in the 5-10 second window. However, even if this were the case, such individuals' responses rarely show the expected return to baseline that should occur after they have habituated to the stimulus, so again the response seems dissimilar to a classical sensory one.

Furthermore, some individuals appear to respond to DMILS in ways which are self-consistent but which do not necessarily correspond to the intended direction. The ones who are responsive do, however, seem to react to any type of influence attempt in a different way than is seen during rest periods. As the standard statistical measure used in EDA-DMILS is based on calm/activate difference, it might perhaps be better to use an influence versus rest analysis. This would not tell us anything about how the intent to affect the target system in a specific direction might affect that system, but might increase the reliability of the basic DMILS effect, allowing better theorising as to possible mechanisms. Once more is known about potential mechanisms, then the more complex area of directional intention could be studied with greater confidence. Such a conclusion is also borne out by other DMILS studies, using a variety of response measures. For example, Braud et al (1993) report on findings using a simple staring/no-staring protocol (comparable to an influence/rest protocol). They find that a variety of studies showed significant results, but that even with this simple protocol, the direction of the effect was not always consistent, apparently altering in response to the participants' attitudes to being stared at. This is again seen in Schlitz & Braud (1997) where a summary of 15 electrodermal-response studies showed that 4 of the direction-specific studies exhibited reversed effects. A further study by Radin (1993) shows a plot (his figure 2) of example data wherein the difference between either type of influence period and rest periods is much greater than the difference seen when comparing influence periods to each other. Although Radin acheived an overall significant finding, one wonders whether a greater and more consistent effect might have been revealed had an influence-rest protocol been used.

One new finding was that the skin-conductance responses recorded during influence periods were significantly more variable that during the rest periods in both studies, the calm period showing the highest variability, then the activate period, then a large drop for the rest periods. The consistency across studies suggests that there is a consistent pattern to EDA-DMILS responses across individuals based on the variance of their responses. Once again, this indicates that future studies might benefit

from using an influence versus rest analysis, but also that taking the variability of the responses into account might result in a more robust measure.

A potential problem with the activate versus calm protocol was demonstrated by the sender physiological activity taken in the Delanoy et al study where it was seen that the sender's electrodermal activity is very similar irrespective of whether they are attempting to activate or to calm the receiver. This implies that they were using an active strategy i.e. getting worked up whilst trying to achieve their aims, rather than attempting to simulate the desired state in themselves, contrary to the expectations of researchers in the field (e.g. Braud, 1994). If DMILS is a purely mental undertaking, then this may not be a problem. However, if there is any physical signal involved in the process (that is, the sender and receiver are involved in some sort of energetic exchange) then this could indicate that there will be a difficulty in distinguishing between calm and activate 'signals'. Presumably any signal would relate to energetic processes in the body, of which physiological activity might be a good indicator on a gross level (physiological arousal tends to correlate with mental arousal). If the sender is experiencing near identical levels of physiological arousal in both influence conditions, then we might expect any DMILS signals to be more similar, at least compared to the lack of signal during the rest periods. It seems likely that an untrained receiver would find it easier to differentiate between the signal/no-signal periods than between two high-arousal signals.

To compare the EDA-DMILS responses to a known stimulus, the data from the Stevens magnetic sensitivity study was studied. As with the DMILS data, no clear sensory-like response was found, but there was an overall slight depressing of the electrodermal activity during field exposure periods. Looking at the mean variance for each individual's responses, the profile was very similar to that seen in the DMILS studies (equating magnetic field exposure periods with Activate, and Control periods with Rest), although the distribution of responses was not as widely separated as with the DMILS conditions and the difference was not statistically significant (possibly due to the lower number of participants used in the MF study). Although not identical, there were a sufficient number of commonalities between the DMILS and MF study responses to encourage further explorations of possible electromagnetic-related mechanisms.

It also appeared that there could be some *a priori* difference in resting physiological activity between those who showed a physiological response after the onset of the DMILS stimulus and those who did not. It was thus suggested that future studies could benefit from pre-selecting participants who had higher lability of their resting physiology, although more research is needed to better define the concept of the ideally labile system: while some degree of lablility might be a good thing, too much runs the risk of losing any effects in the inherent noise of the system.

Recommendations for future studies

- Replace the Activate versus Calm protocol and instead compare simpler Influence versus Rest periods.
- Include a measure of variance of electrodermal responses in the analysis.
- Pay more attention to the sender's physiological reactions. That is, measure the way in which the sender reacts when they are trying to have an effect and only use strategies which actually show a different physio response in them first.
- Pre-select receivers based on high physiological lability.
- Continue research into possible electromagnetic factors.

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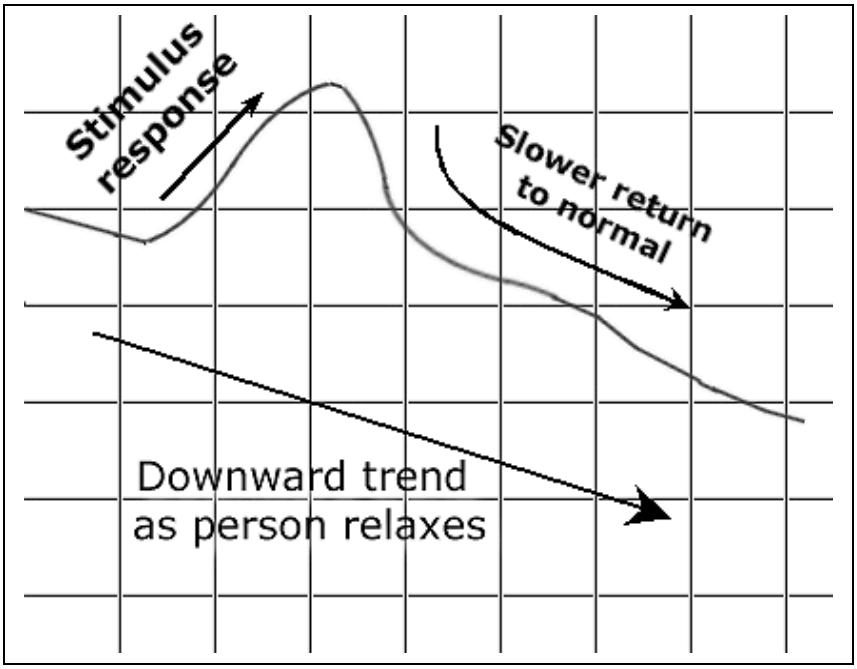

Figure 1: Ideal skin-conductivity response to a sensory stimulus. The y-scale shows the skin-conductance value, the x-axis represents time.

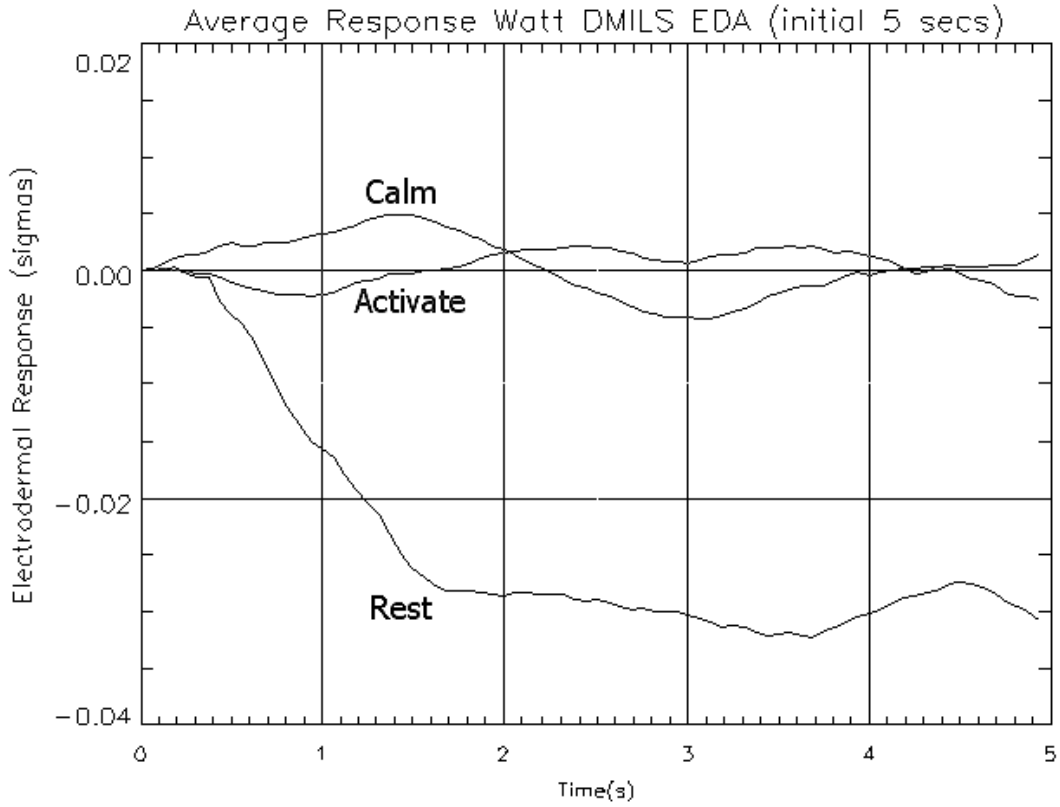

Figure 2: Average skin-conductance values for participants in the Watt study. Plots are of the initial 5 seconds after stimulus onset.

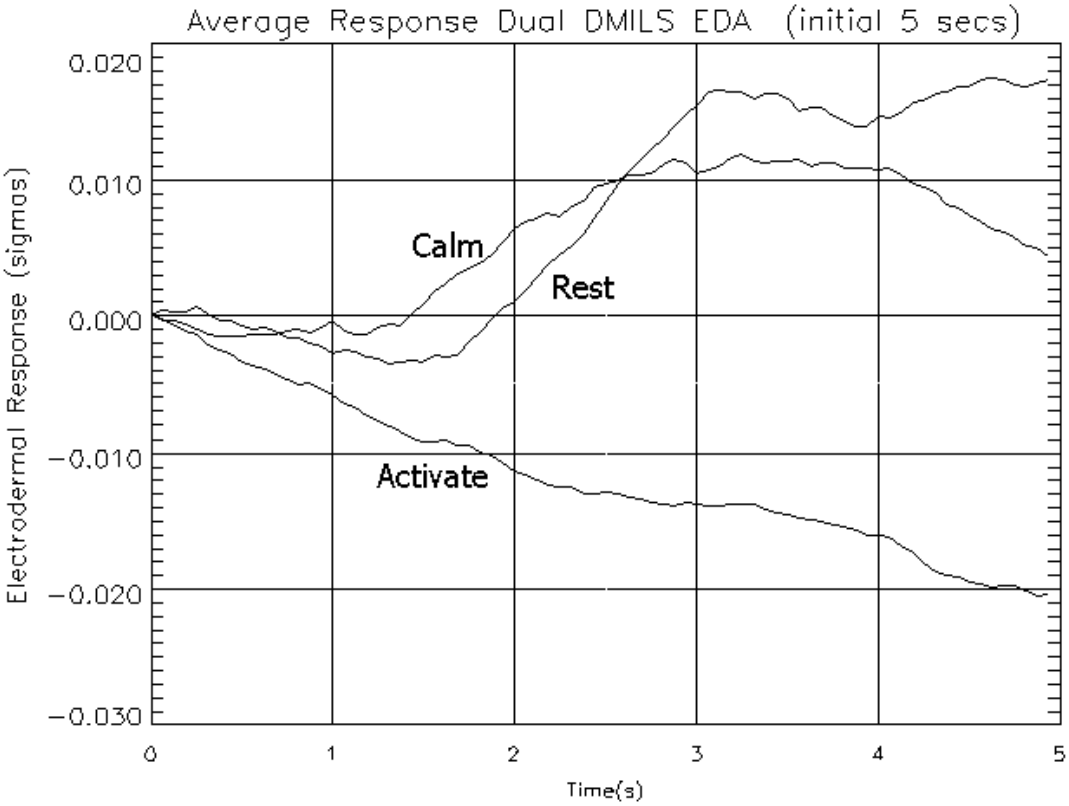

Figure 3: Average skin-conductance values for participants in the Delanoy et al study. Plots are of the initial 5 seconds after stimulus onset.

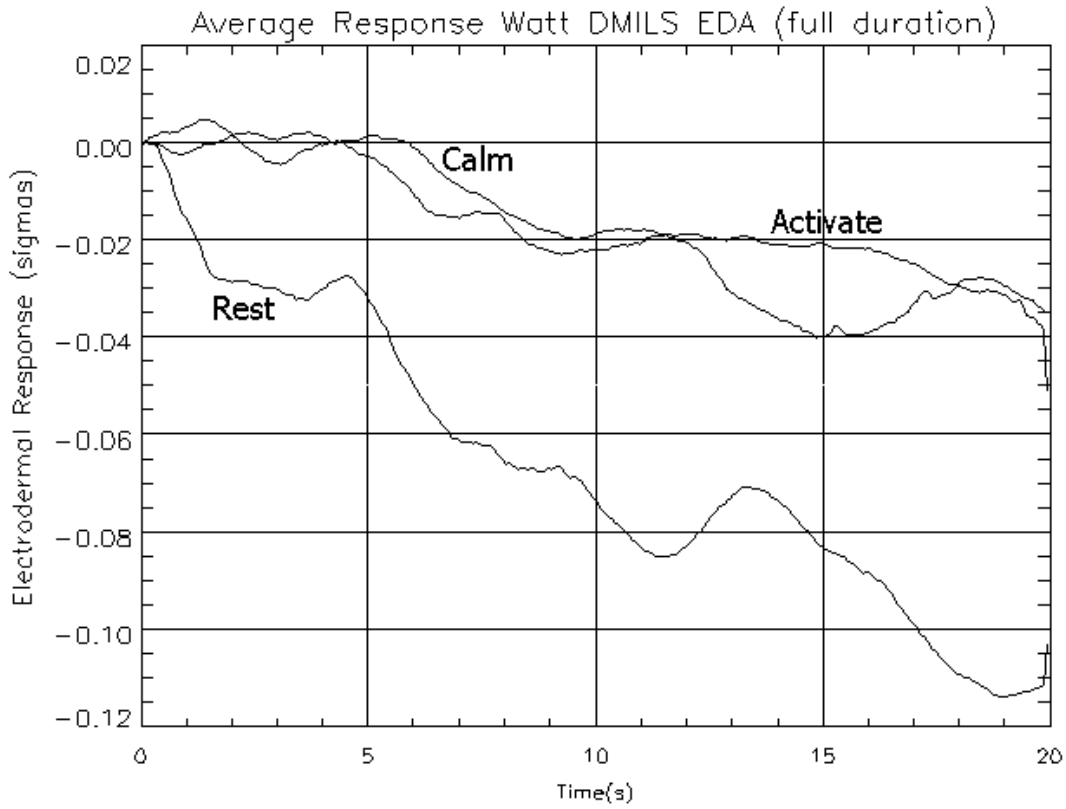

Figure 4: Average skin-conductance values for participants in the Watt study. Plots are of the full 20 seconds after stimulus onset.

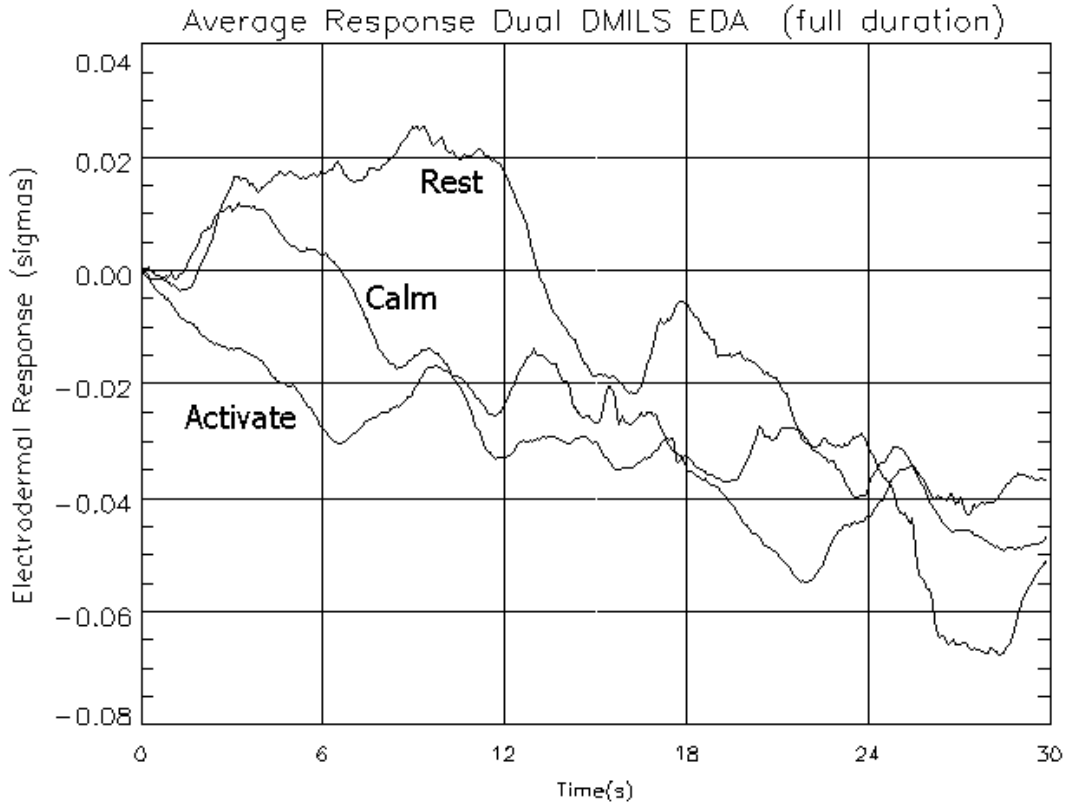

Figure 5: Average skin-conductance values for participants in the Delanoy et al study. Plots are of the full 30 seconds after stimulus onset.

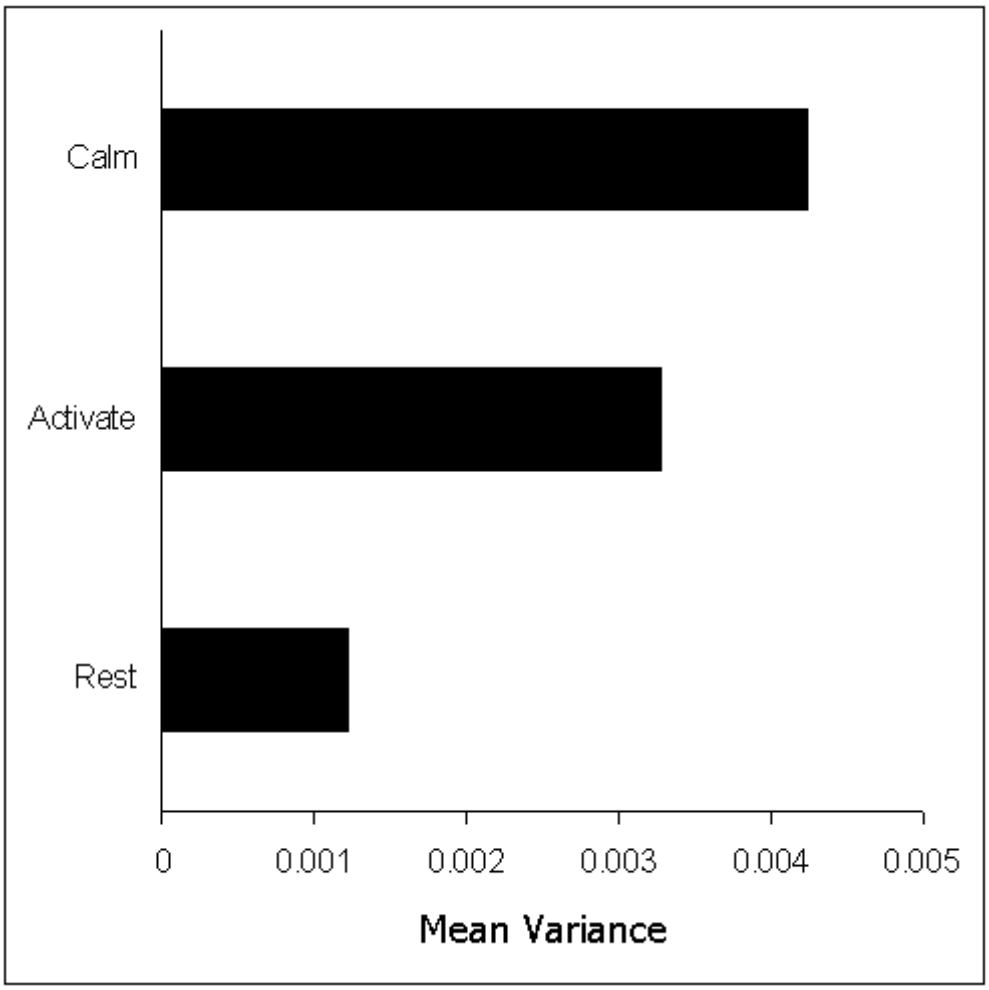

Figure 6: mean variance of skin-conductance values over whole epoch by DMILS condition (Watt et al study)

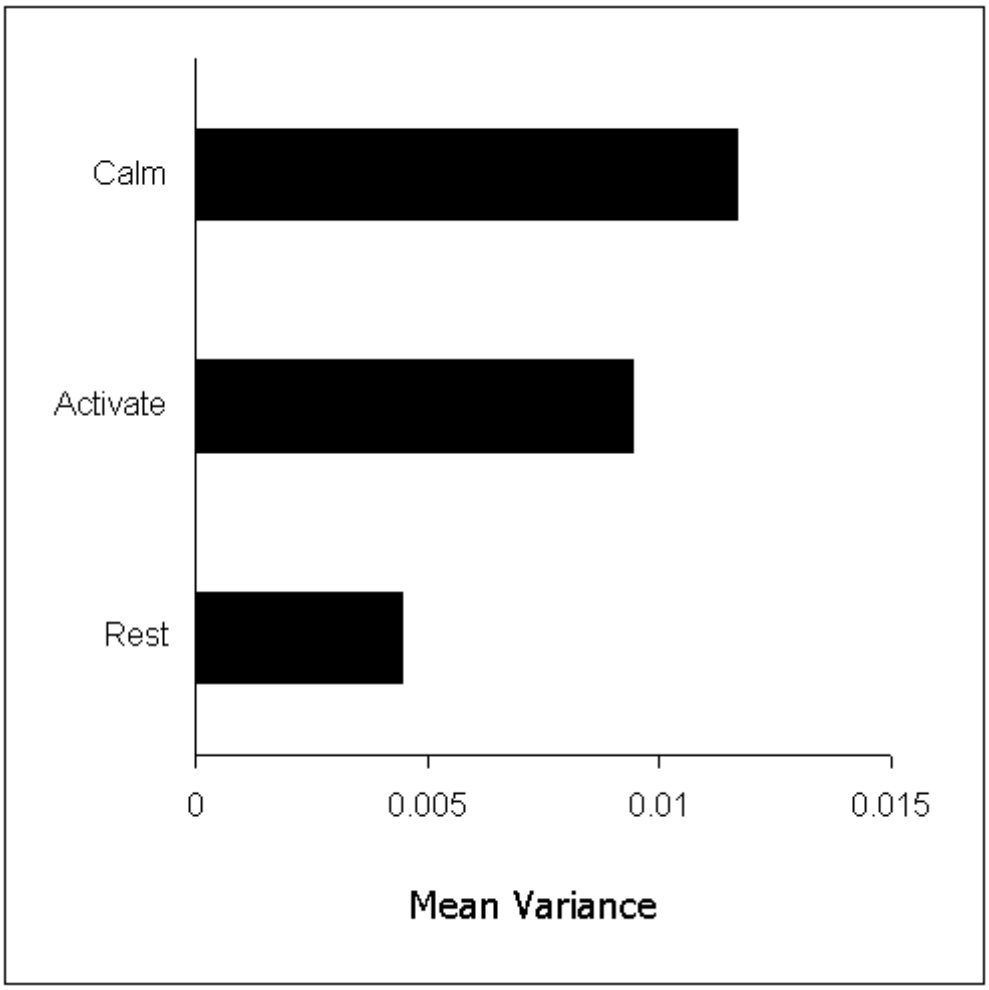

Figure 7: mean variance of skin-conductance values over whole epoch by DMILS condition (Delanoy et al study)

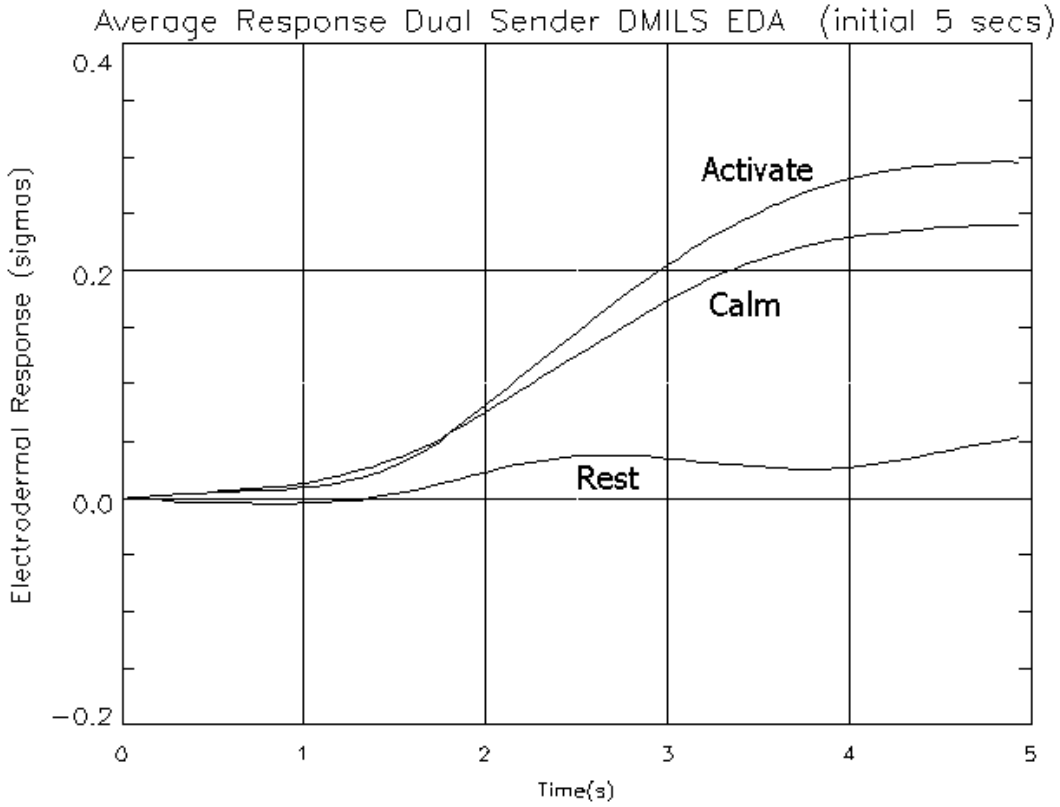

Figure 8: Average skin-conductance values for senders in the Delanoy et al study. Plots are of the initial 5 seconds after period start.

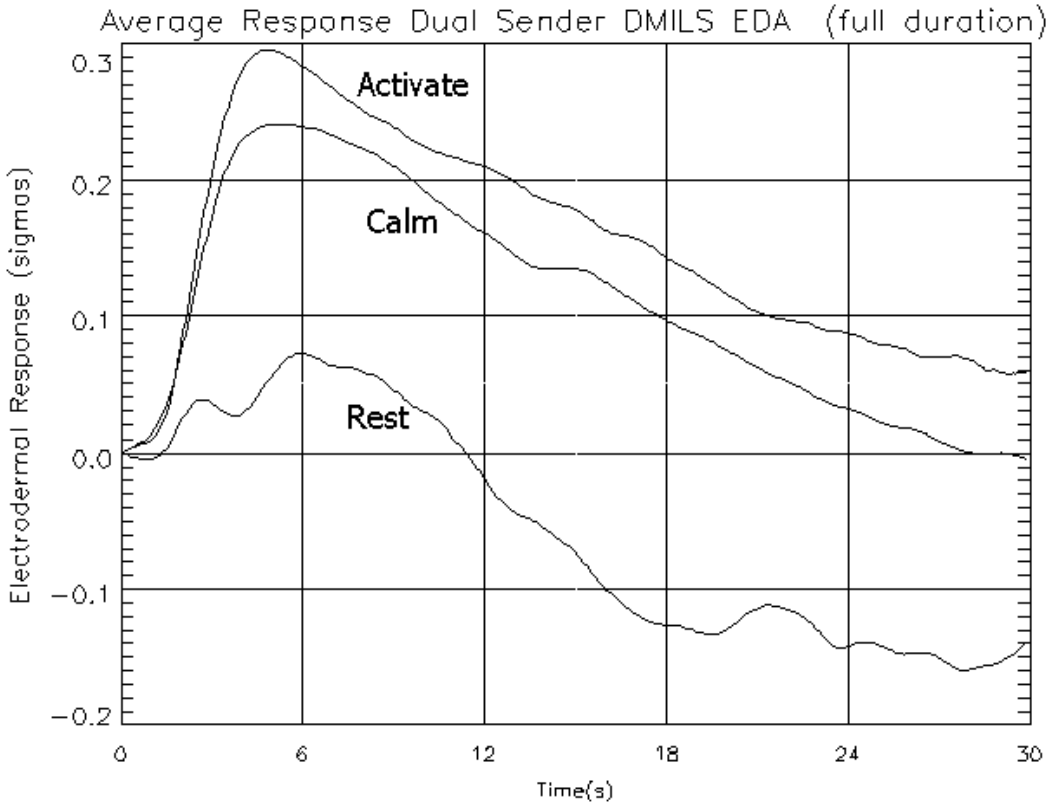

Figure 9: Average skin-conductance values for senders in the Delanoy et al study. Plots are of the full 30 seconds period duration.

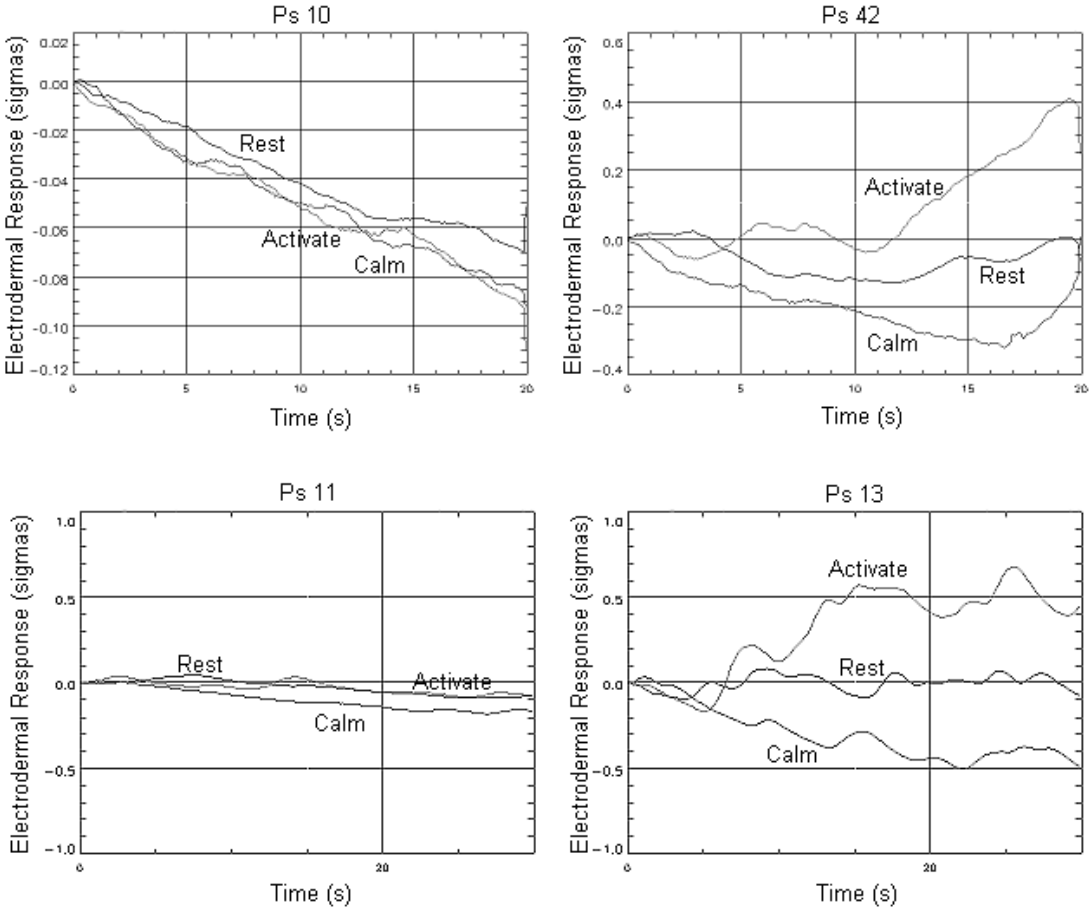

Figure 10: Typical skin-conductance profiles over the whole epoch for Low (on the left) and High (on the right) responders, for the Watt et al (top) and Delanoy et al (bottom) studies

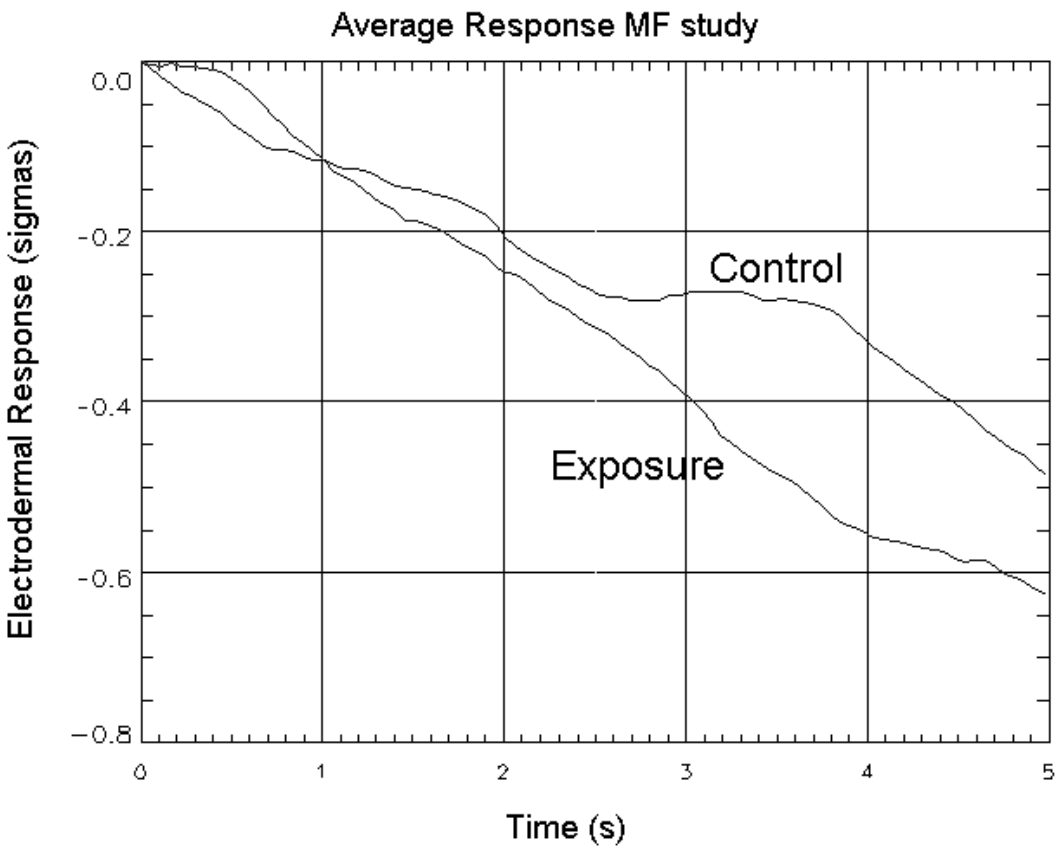

Figure 11: Average skin-conductance values for participants in the magnetic sensitivity study. Plots are of the 5 seconds after stimulus onset.

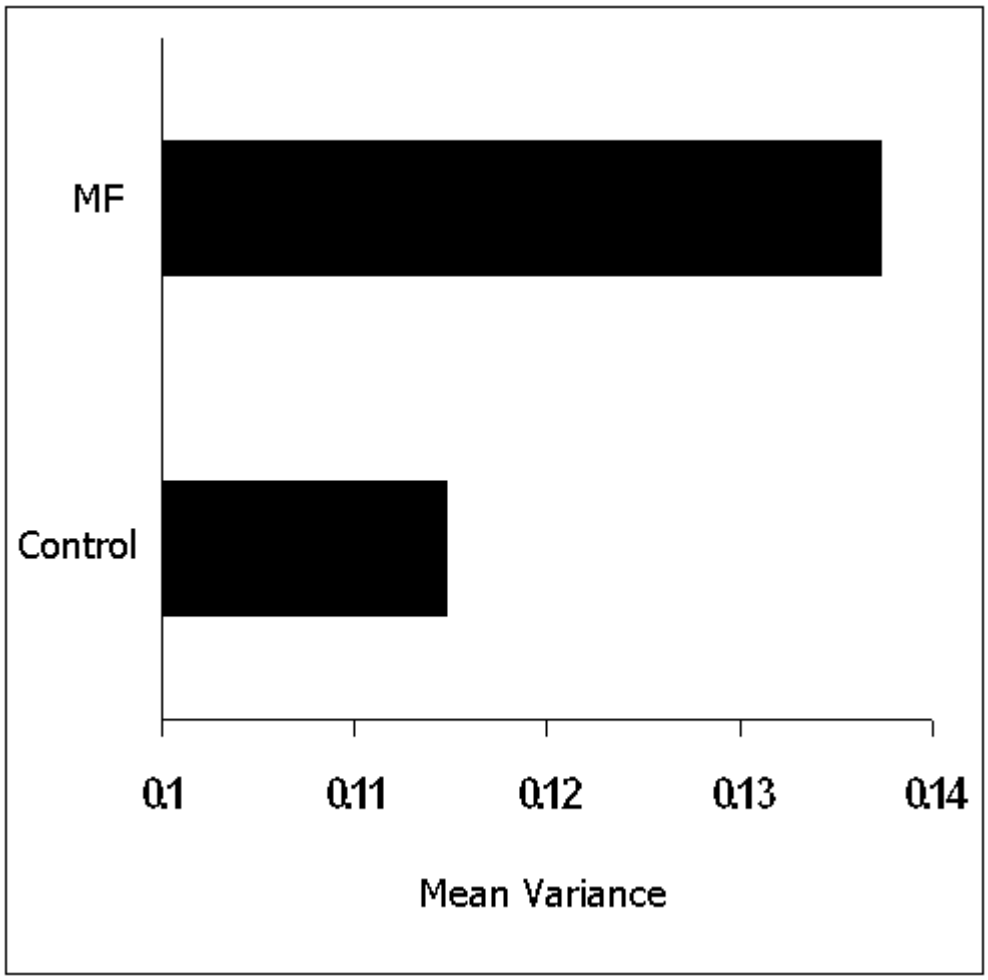

Figure 12: mean variance of skin-conductance values over whole epoch by exposure condition (MF sensitivity study)

Table 1: percentage of skin-conductance responses in intended direction over whole epoch by DMILS condition (Watt et al study)

Condition	Percentage of responses:		
	in right direction	in wrong direction	no consistent response
Activate	37	28	35
Calm	28	44	28

Table 2: Wilcoxon signed-ranks test comparing variance of skin-conductance values over whole epoch in each DMILS condition (Watt et al study)

	Effect Size (Cohen's *d*)	*N*	*p* value (2-tailed)
Activate vs Calm	0.18	43	< 0.0001
Activate vs Rest	0.22	43	< 0.000001
Calm vs. Rest	0.2	43	< 0.00001

Table 3: percentage of skin-conductance values in intended direction over whole epoch by DMILS condition (Delanoy et al study)

Condition	Percentage of responses:		
	in right direction	in wrong direction	no consistent response
Activate	34	58	8
Calm	51	38	11

Table 4: Wilcoxon signed-ranks test comparing variance of skin-conductamce values over whole epoch in each DMILS condition (Delanoy et al study)

	Effect Size (Cohen's *d*) [1]	*N*	*p* value (2-tailed)
Activate vs Calm	0.03	80	0.19
Activate vs Rest	0.10	80	0.0002
Calm vs. Rest	0.13	80	0.0002

[1] The effect size measure, Cohen's *d*, was calculated from the observed Wilcoxon rank sum by transforming the smallest rank sum, *W*, to the approximate normal deviate, *z*, using the formula $z = [0.25\ N\ (N+1) - W - 0.5]\ /\ [(N\ (N+1)\ (2N+1)\ /\ 24\ ]^{0.5}$, given in Snedecor & Cochran (1980). The *z* value was then transformed to Cohen's *d* using the formula $d = [\ 2\ z\ N^{-0.5}\ ]\ /\ [\ N\text{-}1\ ]^{0.5}$, given in Rosenthal & Rosnow (1991).

Table 5: Kolmogorov-Smirnov comparison of rest-period physiological activity of influence-period responders and null-responders

	Mean variance of skin-conductance	*N*	$D_{m,n}$	*p* value (2-tailed)
Watt et al Study				
Null Responders	0.0006	29	0.71	< 0.001
Responders	0.0026	14		
Delanoy et al Study				
Null Responders	0.0023	54	0.41	< 0.01
Responders	0.0091	26		

Table 6: Wilcoxon signed-ranks test comparing variance of skin-conductance values by exposure condition (MF sensitivity study)

	Effect size (Cohen's *d*)	*N*	*p* value (1-tailed)
EMF vs Control	0.11	29	0.09