



PERSONALLY RELEVANT STIMULI DURING ASSESSMENT OF PATIENTS WITH DISORDERS OF CONSCIOUSNESS

In the study by Stenberg et al. (1) they explore whether the use of personally relevant stimuli improves responsiveness in patients with disorders of consciousness. We agree with the authors that an important clinical challenge is to use methods that will improve the likelihood of capturing conscious behaviours. However, we would like to point out that personally relevant stimuli are currently being used in behavioural, as well as neuroimaging, assessments of consciousness.

In general, but specifically in behavioural assessment of cognitively mediated behaviours in patients with disorders of consciousness, it is necessary to place the patient in the most favourable condition. An evaluation carried out in a context that is too natural (unfamiliar, non-emotional), which essentially does not interest the patient, can lead to an underestimation of their cerebral capacities.

To explore the effect of personal relevance Stenberg and colleagues used standardized testing with the Coma Recovery Scale – Revised (CRS-R) (2) on 9 or 10 occasions over a period of 3 weeks. Five further items were included using several personally relevant stimuli. Their results indicate that the visual subscale is highly sensitive to the use of personally relevant stimuli. However, in contrast to the authors' discussion, visual fixation and pursuit has been studied extensively in this patient population. These are the first and the most frequently missed signs of consciousness (3–5), which, furthermore, allow for the highest rate of detection of minimally conscious patients (6–8). The results regarding improved responsiveness to a mirror are in line with recent research showing that a mirror is significantly more effective in triggering visual following compared with a photograph of the patient or a famous person (9).

The lack of correct responses in other items observed by the authors might simply be due to a generally observed decrease in prevalence of these items (8). In the case of auditory localization, this is probably due to the deviation in item administration. Indeed, it has been advised to “call” the subject by their name several times when administering this item, even in a standard CRS-R assessment. As the authors point out, using the subject's own name has been shown to improve frequency of responsiveness (10).

Further studies comparing responsiveness to the CRS-R in relation to personal relevance focus on music. Music has both physical (melody, tempo, etc.) and personally relevant characteristics (familiarity, emotional and autobiographical), making it a significant (arousing) stimulus, which can promote the expression

of cognitive capacities. For example, it was shown that performance on items of the CRS-R improved after the preferred music condition compared with a neutral sound condition (without rhythm or notes) (11). This is in line with indications of possible long-term benefits (12). Furthermore, spontaneous signs of consciousness (e.g. emotional reactions) were more often observed during the preferred conditions (11).

It is important to note that emotional reactions are a sign of consciousness, and are scored in the CRS-R as contingent behaviours (2). It thus seems that the observed spontaneous and stimulus-related emotional reactions observed by Stenberg et al. are in line with the significantly more frequent spontaneous signs of consciousness observed after preferred music in comparison with neutral music or smells (11).

Neuroimaging studies have also shown the importance of personal relevance in disorders of consciousness (for a review see (13)). For example, familiarity has frequently been used to capture attention and evoke emotional reactions and activation of the emotional brain-networks (14), or face-selective areas (15) in response to a familiar voice. Furthermore, both electroencephalography (EEG) and magnetic resonance imaging (MRI) studies have shown the importance of using the subject's own name. Evoked potentials, such as the P300 response after using the subject's own first name, can be observed (16), and is seen more often in comparison with a tone (17). Brain responses to the subject's own name might furthermore be linked to a positive outcome (18, 19). One explanation is that arousal is stimulated through sensory stimulations when personal relevance is taken into account (20).

Beneficial effects of music have also been observed using EEG and MRI. The number of patients for whom a p300 evoked response is observed doubled after the presentation of preferred music, and was linked to a positive evolution (21). The personally relevant characteristics of favourite music might be responsible for these effects. A preliminary functional magnetic resonance imaging (fMRI) study indicated increased functional connectivity in the dorsolateral prefrontal cortex involved, among others, in autobiographical memory (22).

These studies thus seem to imply that a preferred context, due to its personal relevance, is capable of evoking behavioural responses that are limited or absent in a neutral context (as often present in clinical evaluations). As Stenberg and colleagues point out, the use of personally relevant stimuli is necessary during evaluation. The use of more complex stimuli, such as

preferred music, might be a tool to, at least temporarily, improve the general context of assessment and thus expression of residual cognitive functions.

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RESPONSE TO LETTER TO THE EDITOR FROM HEINE & PERRIN

We would like to thank Heine & Perrin for their interest, and insightful comments on our recently published study (1). We agree that the context of the assessment is of great importance. As Heine & Perrin argue, preferred music is a personally relevant stimulus with great potential to generate responses in this patient group.

Some of the points Heine & Perrin are making deserve clarification. Firstly, we are aware of the studies exploring visual fixation and pursuit with personally relevant stimuli. In the introduction, as well as when discussing our results, we refer to these studies (23–26). Our attempt with the present study was to replace *several* of the stimuli traditionally used in CRS-R assessments, with personally relevant ones. The value of such incorporation of personally relevant stimuli throughout an assessment with CRS-R is still to be determined. Future studies exploring what kinds of stimuli, for which items in the CRS-R, have the greatest potential to generate responses, are warranted.

As Heine & Perrin mention, visual pursuit often is the first sign of a minimally conscious state (MCS) (7).

Regarding other items administered with personally relevant stimuli in our study, Heine & Perrin state that “the lack of correct responses in other observed items by the authors might simply be due to a generally observed decrease in prevalence of these items”. There are many possible explanations for the lack of correct responses in these items; Heine & Perrin mention one explanation. In the current study, we discuss and emphasize that, due to the low number of participants, negative findings must be interpreted with caution. We welcome larger studies that include music and other personally relevant stimuli in a standardized assessment, to further develop behavioural scales for the systematic clinical evaluation of consciousness.

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