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**Alleged “sonic attack” supported by poor Neuropsychology**

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Swanson et al. (2018) recently reported in JAMA their findings on neurological, behavioural and cognitive symptoms linked to perceived sounds among US diplomats and personnel in Havana, Cuba. The story has been branded by the media as a “sonic attack”, implying that employees of the US embassy could have been the target of unknown sound waves provoking a variety of symptoms, including cognitive problems. The incident caused a great deal of turmoil between the two countries. Here we comment on the neuropsychology data supporting the claim of the existence of a novel syndrome akin to acquired brain injury but without any history of brain trauma and no indication of brain abnormalities.

The JAMA article represents a case of poor neuropsychology; clinically inappropriate and methodologically improper.

Only six of the 21 people considered in the study completed the battery of 37 tests. Results are reported in eTable 2 of the Supplementary Material. No demographic data are provided, nor are the raw scores supplied - only percentiles are given.

In eTable 2, the authors report as ‘impaired’ any performance below the 40<sup>th</sup> percentile. They write “Bold highlighting denotes abnormality or <40<sup>th</sup> percentile” and quote three text manuals, none of which authorizes the use of such high threshold as cut-off. The use of an arbitrarily high threshold gives rise to numerous false positives. Assessing any group of normal, healthy people with a random battery of tests using such a high threshold would result in several of them performing below the chosen cut-off score in one or another test.

The authors used a mere psychometric approach. To use a list of tests and count the number of scores below threshold is misleading. For example, they state that “Impairments were found in the executive function” (p. E4) in all of the six people tested. They supported this claim by highlighting that all the testees performed below the 40<sup>th</sup> centile in at least one of the six tests assessing executive functions. The authors’ assumption therefore is that performing below the 40<sup>th</sup> centile in one test is enough to diagnose a deficit in that function.

Even with the scant information provided we can inspect the six cases whose performance is reported in eTable 2. Setting the threshold of normality at the 5<sup>th</sup> centile, as it is custom in clinical neuropsychology, cases four, nine and 15 would perform normally in all tests.

Case 11 would fail the two motor tests and one of the three reasoning tasks administered (Visual Puzzles) and Case 13 would perform below cut-off only on Categorical Verbal Fluency. Case 20 is more complex. This person would perform pathologically on six of the 37 tests administered: one

memory task (California Verbal Learning Test – II: Long Delay), one visuo-perceptual test (Judgment of Line Orientation), a motor task (Grooved Pegboard: Dominant), a test of attention (Symbol Search) and two executive tests (Trail Making Test: Part A and B). This profile of spared and impaired performances does not configure a systematic pattern; the lack of coherence makes it impossible to advance any neuropsychological diagnostic interpretation.

The core competence of a neuropsychologist is not solely to administer tests, but to unravel the observed pattern of performance. Central to this remit is the interpretation of the outcome from tests, based on both accuracy scores and the qualitative analysis of errors. Neuropsychology is not Psychometry. Any performance on a given test is *per se* opaque. To probe a cognitive function, one single test does not suffice, as the test-function correspondence is weak. Moreover, the performance on a single test may be impaired for multiple reasons.

In conclusion, there is no evidence that the people assessed present with any cognitive deficit (to be linked or not with their stay in Cuba). Subjective cognitive symptoms cannot be supported by the reported data. There is no “new syndrome” to contemplate. Hence, the search for its cause is moot.

In the accompanying editorial, Muth and Lewis (2018) justify the publication of a paper reporting observational data difficult to account for by arguing also that when Wernicke and Korsakoff described their cases, little was known about the causes leading to what became the eponymic syndrome. We agree; indeed, we have recently launched in *Cortex* the possibility of publishing Exploratory Reports (McIntosh, 2017). However, the memory impairments observed by Korsakoff were severe, coherent and described in detail. Had he postulated the existence of cognitive deficits using a random list of tests with a threshold at the 40<sup>th</sup> centile, Muth and Lewis would have taken him less seriously. Exploratory reports should be solid.

Whether the publication of a neuropsychological report clearly below par in a highly respected journal has been dictated by a political agenda we have no means to fathom. Similarly, with limited information it is difficult to postulate alternative accounts of the phenomenon (Bartholomew, 2017). Reports of acoustic attacks are not new, spanning from the Jericho trumpets to the Kokomo Hum. However, this is the first time that neuropsychology has been used formally to endorse unfounded claims. We limited our appraisal to this aspect of the report.

The condition suffered by the US diplomats in Cuba has been labelled “mysterious” (Rubin, 2018). The real mystery though is how such a poor neuropsychological report could have passed the scrutiny of expert reviewers in a first class outlet.

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