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Is obesity linked with episodic memory impairment? A commentary on Cheke, Simons & Clayton (2016)

Scott N Cole & Kata Pauly-Takacs

In a recent paper published in the *Quarterly Journal of Experimental Psychology*, Cheke, Simons & Clayton (2016) report a study investigating the link between Body Mass Index (BMI) and episodic memory. The study was motivated by two lines of argument. Firstly, that obesity can lead to neurological changes that result in a decline in episodic memory function. Secondly, that episodic memory plays a role in regulating eating behaviour, and thus BMI. Fifty young participants were tested on a novel episodic memory task (termed the Treasure Hunt Task) and their BMI, age, level of education and gender were recorded. Participants' BMIs ranged from 18 to 51 including lean, overweight and obese individuals. Stepwise linear regression analyses were conducted to test whether BMI - or other factors - predict episodic memory performance. The authors interpreted their results as supportive evidence for the hypothesis that "individuals with higher BMI may exhibit a deficit in episodic memory relative to lean controls" (Cheke et al, 2016, p. 9).

Due to the increased focus on obesity in western societies, the study has gained considerable media interest with alarming titles such as *Obesity linked to 'worse memory'* (BBC), or *Obesity linked to memory deficits* (The Guardian). However, three main aspects of the original article concern us, especially the proposed explanations of the BMI-memory link, which seem premature based on the results published by Cheke et al (2016).

The first issue is the memory task and its associated measures. An episodic memory 'Treasure Hunt Task' was adopted from memory research on nonhuman animals. The task involved remembering *what*, *where* and *when* objects were hidden in various scenes. The task can be decomposed into four measures; a WWW measure that involves recalling the bound event representation (i.e., episodic

memory), and independent *what*, *where* and *when* measures each based on a series of forced-choice recognition memory questions. In general, this task is based upon a conceptualisation of episodic memory that is over 40 years old (Tulving & Donaldson, 1972, cited in Cheke et al., 2016) which omits the subjective recollective experience that Tulving (2000) himself and others (e.g., Conway, 2009) now hold as an indispensable marker. A well-established approach to measure episodic memory is through reports of subjective judgments of *recollection* as opposed to *familiarity* or *knowing*, which reliably discern the processes underlying long-term memory (Gardiner & Richardson-Klavehn, 2000). Moreover, considering the range of neurocognitive processes that plausibly contribute to over-eating, other aspects of cognition, especially executive function (e.g. inhibition, cognitive control) will be important to measure. Indeed, as executive functions are involved in the control of food intake (Davidson, Tracy, Schier, & Swithers, 2014, as cited by Cheke et al, 2016), experimental tasks measuring the ability to control memory, such as the process dissociation procedure (which distinguishes between recollection vs. familiarity as controlled and automatic components, respectively) (Jennings & Jacoby, 1997), might serve as a powerful paradigm for investigating differences in memory as a function of obesity. Finally, measuring the phenomenological characteristics of episodic memories (e.g. overall vividness, perceptual details, emotional valence), especially those related to food intake, could also help elucidate the role of memory in obesity.

The second point of concern is the findings. To test their hypothesis, the authors analysed whether BMI predicted variability in performance on the four measures from the Treasure Hunt Task. They controlled for age, gender and years in education in four stepwise regression analyses. The principal analysis showed that BMI did not predict a significant amount of variance on the WWW measure after the demographic factors were added to the model. Thus, BMI did not predict episodic memory any more than age, gender and years in education. BMI did predict variance in individual *what*, *where* and *when* components, but it is unclear how these relate to episodic memory processes because they do not require event binding. It should be noted that the multiple regression analyses were performed with a relatively small sample size ($N=50$). This lack of power (increasing the chance of a Type 1

Error), in addition to apparent skewness of data on both the x and y axis (see Figure 2, p.7), which was used with a parametric-based analyses (i.e., linear regressions) are concerns that should warrant caution when interpreting the regression models.

The last, most concerning, point is related to Cheke et al's (2016) conclusions drawn from their data suggesting that individuals with high BMI may exhibit episodic memory deficits. We find this conclusion problematic for two reasons. First, performance on the WWW measure, which is arguably the only theoretically-motivated measure that reflects episodic memory function (i.e. contextually-bound representation), was not predicted by BMI. Whilst individual *what*, *where* and *when* performance was predicted by BMI, how these map on to episodic memory function is less clear and no theoretical explanation is offered as to why one would expect *these*, but not the WWW, to be predicted by BMI. Second, the correlational design does not permit inferences about obese individuals having a memory deficit because there is no cut-off for impaired performance. In this design it is not clear whether memory scores simply reflect normal variation. Establishing impaired performance in the Treasure Hunt Task would require a quasi-experimental between-groups design with a sizeable healthy control group.

With this commentary we were motivated to highlight a more general issue in psychological science: When and how should we communicate our results? Does a 'publish or perish' imperative breed a culture of publishing preliminary findings? In this case, findings have been relayed to the public via worldwide media outlets, with the majority of news articles making bold claims about memory impairment in obesity. Although in the original article the authors acknowledge many important caveats and limitations (e.g., small sample size, comorbidity, validity), the media will extract the central conclusion without much rigour, especially if it relates to key societal issues, as seen in this case. Our position is that we, as experimental psychologists, have a responsibility to exert caution when communicating preliminary findings.

In sum, in the complex 'syndrome' of obesity it is likely that many cognitive factors are involved in the maintenance of a sedentary lifestyle and excessive energy intake. We would call for extreme

caution, however, before saying that overweight individuals have poor memories. Such a view would be premature and potentially misleading. Food for thought.

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