Modality Specificity Trumps Other Methods for Diagnosing the Auditory Processing Disorder (APD): Response to Dillon et al

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Modality Specificity Trumps Other Methods for Diagnosing the Auditory Processing Disorder (APD): Response to Dillon et al

In their letter to the editor, Dillon et al make two major points: (1) they question the need for multimodal testing (their term: *cross-modal testing*), and (2) they question the need for showing that performance is deficient on two or more tests of auditory processing. Dillon et al note that multimodal testing is not performed with tests of hearing sensitivity. Although this might be true, the more important issue we wish to emphasize is that supramodal factors can be involved in auditory detection tasks (e.g., Zwislocki et al, 1958) as they are with current tests for assessing disorders of auditory processing (e.g., Silman et al, 2000). Dillon et al raise the issue of potential comorbidity of auditory disorders with other disorders of sensory processing. We reviewed this point in our original discussion of modality specificity (McFarland and Cacace, 1995; page 37). Basically, this type of case would make diagnosis difficult. However, if a test is useful for diagnosing auditory processing disorders (APDs), then it should be possible to demonstrate modality-specific auditory disorders in a proportion of cases (Cacace and McFarland, 2005; page 116), assuming of course that this follows the theoretic construct described by McFarland and Cacace (2012). Dillon et al also suggest the possibility of ruling out nonauditory factors using the principle of "differential conditions." Their principle of differential conditions applies when two tasks differ greatly in the demands they place on auditory processing skills, but differ minimally in the demands they place on cognitive abilities. As an example, they use the Listening in Spatialized Noise Sentences (LiSN-S) test, which compares conditions where auditory skills can or cannot take advantage of spatial separation of the target and competing sounds (Cameron et al, 2009). This approach is essentially a dissociation design, as described by Cacace and McFarland (2012). In the example given in their letter, Dillon et al are dissociating spatial versus non-spatial listening tasks, in contrast to dissociating auditory versus visual tasks (i.e., the established way to determine the modality specificity of the deficit in the assessment for APDs). Although useful, their approach does not rule out the possibility that individuals under consideration can have "supramodal" spatial deficits. In this sense, demonstrating modality specificity would be much more informative and useful to establishing diagnostic specificity.

Furthermore, in addition to lacking specificity, Dillon et al do not provide a theoretic framework to support their position. As we have emphasized many times, using auditory tasks alone to evaluate APD does not ensure that the deficit is limited to the auditory sensory modality. Moreover, regarding theory, or in this case lack thereof, also underscores (1) the absence of a clear definition of what an APD is; and (2) as a consequence, the absence of a criterion to ascertain if results would be consistent with theoretic expectations.

Dillon et al also question the need for establishing that there are deficits in two or more tests of auditory processing. It is quite possible that auditory processing deficits could be circumscribed, being limited, for example, to auditory spatial processing. However, it is still reasonable to expect that other tests of auditory spatial processing would also be deficient. Otherwise, it is not clear that results would have any generality beyond the performance of the single test in question.

SOME ADDITIONAL POINTS RELATED TO THE PSYCHOPHYSICAL METHOD AND THE IMPORTANCE OF RESPONSE SELECTION

We also take issue with the position of Dillon et al with respect to psychophysical methodology. In our hands and based on the work of many others, forced-choice procedures are powerful and efficient methods not only for establishing thresholds but for other reasons such as structuring the testing environment, providing reinforcement throughout the experiment; controlling for response bias and decision processes; avoiding floor-and-ceiling effects; providing the same level of difficulty across tasks; converging upon threshold in an efficient and timely manner (particularly if an adaptive approach is applied); and, of course, automation of scoring. In our current study (Cacace and McFarland, 2013, page 582), we describe successful applications or variants of this approach in a variety of experimental paradigms, including auditory and visual recognition memory, memory span for binary sequential auditory and visual patterns and visual spatial stimuli, memory decay, and temporal-order discrimination and in assessing the pitch and loudness level of tinnitus. Moreover, the usefulness of forced-choice adaptive procedures considers their application in diverse clinical populations (i.e., adults and children, in individuals with and without brain lesions, in those with reading problems, and in different otopathologic conditions). Our extensive experience in this area allows us to endorse this approach with confidence. Based on work performed at the Medical Research Counsel in Nottingham (see Amitay et al, 2006) and in commercial applications (MindWeavers, PLC), Moore and colleagues seem to favor using this methodology as well. Without belaboring this point, it has been established that in children as young as 3 yr old, frequency discrimination performance based on an adaptive forced-choice psychophysical procedure (embedded within a videogame format) produced data that were qualitatively indistinguishable from adults (Allen et al, 1989). In addition, Mates et al (2001) emphasize that brain-injured patients with aphasia and children with specific language and learning impairments can be trained effectively on auditory and visual temporal-order tasks, particularly if feedback is incorporated into the forced-choice adaptive procedure. Indeed, this has been our experience with both adaptive forced-choice auditory and visual temporal-order tasks designed to converge on a threshold-of-interest and when the forced-choice paradigm is used to construct complete psychometric functions using a block-randomized design (Cacace et al, 2000). In this later study, we showed that perceptual deficits observed in remediation-resistant reading-impaired children were neither modality specific nor temporal specific and that significantly elevated frequency and intensity discrimination thresholds (i.e., just-noticeable differences) were also observed. The point of interest here centers on the usefulness of multimodal testing and the ability to assess directly if a deficit is modality specific, polysensory, or supramodal.

Dillon et al also take issue with our arguments criticizing the use of complex motor reproduction tasks as a form of response selection, particularly when "humming" or "singing" is used and when performances on frequency, intensity, or duration patterns tasks (i.e., paradigms that are commonly used in clinical APD assessments) are being considered. Dillon et al subscribe to the view that the simple click of a mouse button (a form of response selection in a forced-choice recognition paradigm) is equivalent to those complex sensory and motor processes involved in singing or humming. From our point of view, it is a naïve position to take, but of course, it depends on the intent of the investigator and the experiment under study. For example, if the investigator is interested in studying motor abilities and/or skills, then use of a motor reproduction task such as humming or singing would be fine. However, if the intent of the investigator is to study perceptual abilities, then limiting the use of motor-based response selection tasks would be considered much more advantageous and a preferred approach. To emphasize this rationale and distinction, we also provided examples in our publication where using motor reproduction confounds test results by producing interference underlying memory processes, as can be the case in studying serial position effects using auditory and visual binary sequential stimuli (see current paper, page 585, Cacace and McFarland, 2013) and in highlighting differences in dichotic listening performance when comparisons are made between recognition versus reproduction.

Clearly, investigators are entitled to their "opinions" about the relative usefulness of psychophysical methods such as forced-choice adaptive procedures and/or other concerns (Dillon et al, 2012). However, this is an empiric issue and these methods have proven to be quite useful in mainstream psychophysics; their worth for assessing APDs has also been apparent and will emerge from future data. Nevertheless, we emphasize that the criterion of modality specificity is a matter of definition, rather than an empiric issue.

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