Auditory measures of intelligence and intelligence-related functions: Where have we come from and where to from here?

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DECLARATION

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* Zajac, I. T., & Burns, N. R. (2011). Relationships between three auditory inspection time tasks and processing speed. *Australian Journal of Psychology*, 63, 163-172. doi: 10.1111/j.1742-9536.2011.00020.x

* Zajac, I. T., & Burns, N. R. (*in press*). Do auditory temporal discrimination tasks measure temporal resolution of the CNS? *Psychology*

Ian T. Zajac

Signed…….Date……

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SUMMARY

Much of what is known of the nature of human intelligence derives from research concerned primarily with visually presented tests. This thesis, on the other hand, sought to extend this knowledge by exploring intelligence as expressed in the auditory modality. More specifically, the dissertation reports on a series of studies designed to broadly examine the extent to which existing broad ability constructs defined in modern intelligence taxonomies are expressed in performance on auditory tasks. The reason for doing so reflects the largely untested assumption that constructs like fluid and crystallised intelligence, for example, are not modality specific but cognitively general.

Study 1 aimed to purposely design auditory tests to measure the broad construct general speed of processing (Gs). *N*=96 university undergraduates completed these new auditory tasks together with a selection of existing putative auditory Gs measures, and also a selection of established visual Gs marker tests. The new auditory tasks were found to display good reliability and, together with the visual tests, they defined moderately correlated broad Gs and RT speed factors.

Study 2 extended the findings of Study 1. In particular, in light of the under-representation of visual tasks in the previous study, it sought to increase the number of visual Gs tests to investigate the presence of modality specific speed factors. *N*=80 university undergraduates completed the test battery. Several structural models were tested in which modality specific speed factors were specified; however, these models were not supported. Instead, results supported those found in Study 1: auditory and visual tests combine to define broad Gs and RT speed factors.

Study 3 examined existing measures of temporal discrimination. Although it has recently been suggested that these tasks provide a direct measure of neural efficiency they appear in fact to be cognitively complex, possibly relying on memory functions. Therefore, *N*=66 university undergraduates completed a battery of tests measuring temporal discrimination, memory (Gm) and speed (Gs). Results showed that temporal tasks related more strongly and consistently with Gm than Gs. Further re-analysis of previously published data supported these findings with Gm functions mediating the relationship between temporal tasks and general intelligence.

Study 4 explored Auditory Inspection Time (AIT) tasks and their relationship to measures of Gs. *N*=96 university undergraduates completed these tasks and measures of Gs. Of the three variations of AIT, only the spatial version related well to Gs. A distinct and independent AIT factor was also identified which supports previous suggestions that these tasks largely reflect auditory perceptual processes.

Based on the results of all studies it is concluded that broad constructs defined in intelligence theories can be indexed auditorily provided that sufficient effort is devoted to ensuring the auditory tasks emphasise the cognitive processes underpinning the constructs of interest. Further, it is recommended that future studies of the auditory modality consider their tasks in relation to existing broad constructs and that auditory tasks be incorporated into intelligence testing.

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LIST OF ACRONYMS

AC	Audio Code
ACoR	Auditory Cognition of Relations
AFF	Auditory Flutter Fusion
AIT	Auditory Inspection Time
AIT-L	Auditory Inspection Time – Loudness
AIT-P	Auditory Inspection Time – Pitch
AIT-S	Auditory Inspection Time – Spatial Localisation
AP_d	Auditory Pitch Discrimination
APM	Raven's Advanced Progressive Matrices
ART	Auditory Reaction Time
AT_d	Auditory Temporal Discrimination
CCFT	Cattell Culture Fair Test
CD_A	Chasing Digits Auditory
CD_V	Chasing Digits Visual
CFA	Confirmatory Factor Analysis
DaSP	Discrimination among Sound Patterns
DD	Duration Discrimination
DM	Dot Matrix
ECT	Elementary Cognitive Task
EFA	Exploratory Factor Analysis
FAs	Finding (Letter) As
FSIQ	Full Scale IQ (Intelligence Quotient)
g	General Intelligence
Ga	Broad Auditory Reception
Gc	Crystallised Intelligence

Gf	Fluid Intelligence
Glr	Learning and Retrieval; Long-term Memory
GRT	General Reaction Time
Gs	Speed of Processing
Gsm	Short-term Memory
Gt	General Timing Ability/Factor
Gv	Visualisation
HAs	Hears (Letter) As
IT	Inspection Time
NC	Number Comparison
RP	Rhythm Perception
RPM	Raven's Progressive Matrices
RT	Reaction Time
SD	Symbol Digit
SEM	Structural Equation Modeling
SPuD	Speech Perception under Distraction
TC	Tone Comparisons
TG	Temporal Generalisation
TOJ	Tonal Order Judgement
VIT	Visual Inspection Time
VL_d	Visual Line-Length Discrimination
VRT	Visual Reaction Time
VT_d	Visual Temporal Discrimination
WM	Working Memory