

Appendix A

Metasubjective Task Analysis (MTA)

Design of the two verbal and visuospatial WM paradigms were guided by *Metasubjective Task Analysis* (MTA) and closely followed the MTA for the CMT by Arsalidou *et al.* (2010). MTA is a rationally based method of inquiry that attempts to explain human performance by delineating an individual's analytical approach in finding a task solution [16]. This casual analysis uses abstracted probabilistic patterns of representation and action (e.g. figurative and operative schemes, respectively) to decompose tasks into performance components that are ordered in time. The steps required to solve LMT-Complex is summarized in the equation below:

- (1) [SCAN&IDEN]^{L1} ({#IGN: a, irrL, locL, repL}_{L1} #Ex < cl1, cl2, ...cln> tli)

Scan and Identify relevant stimuli [A, B, E, H, K, M and N] while ignoring irrelevant letters [O and P] and the location and repetition of such letters. Active extraction of letters from the first figural A (target set) are carried over for comparison with letters in the following figure (criterion set).

Individually scan and identify (SCAN&IDEN) each letter embedded in the presented figural A. While scanning and identifying the target set participants concurrently (#IGN) ignore: the figural A (a), irrelevant letters (irrL), and the location (locL) and repetition of letters (repL). Chunking of these sequential steps, shown within the curly brackets, are symbolized by the *L1* subscript. Participants are then required to actively extract (#Ex) criterion letters from the preceding figure and match one by one with proceeding target letters (tli). Number of relevant letters presented in the criterion set varies in accordance to task difficulty ($n = 1-6$).

- (2) [MATCH&PRESS (<cl1, cl2, ...cln> tli)]

Match each letter from the target set with those in the subsequent criterion set, pressing same or different response buttons for each figure.

As a continuation of step 1, participants are required to match each criterion letter (cl1) with subsequent target letters (tl), while keeping in mind the operative (action) scheme to MATCH & PRESS the binary response button.

- (3)[RESET^{L3}/RECUR^{L2} ({#set.c'←}L3 set.t/#set.t:{tli'←tli }L2)]

Once a response has been selected, the criterion set is then turned into the target set and relevant letters are held in mind to match with the next stimulus set.

The dual function of RESET and RECUR is denoted by the (/) incompatibility sign. Each function is implemented individually, not collectively, as needed. RESET is applied to each successive figure to ensure the target set of letters (set.t) are carried over and changed (←) into the new criterion set (set.c'). These evolving changes (#set.c'← set.t) are chunked, as shown by subscript *L3*. RECUR function serves to identify and compare target letters (tli) with other target letters (#set.t: tli'←tli) that have not yet been matched; this chunking is signified by *L2*.

$$\text{WM Capacity in LMT Complex} = n (\text{relevant letter}) + 2$$

Superscripts *L1*, *L2*, *L3* symbolize the boosting process of multiple, related, task relevant schemes that work together to form one unit of *M*-energy ($n + 1$).

The inclusion of a distractor (figural A) impedes subject's ability to actively scan and identify (SCAN&IDEN) relevant letters, and subsequently extract (#Ex) and match embedded letters with proceeding stimuli (target set). An additional unit of *M*-energy is accordingly added to each subject's WM capacity score

In finding a task solution, participants must implement an overall executive strategy which embodies the operative (procedural; CAPITAL LETTERS) and figurative (object, property or representation; lower case) schemes represented in the aforementioned steps. Parameters (#) prescribe conditions to the application of operatives, which are driven by situational features or theory-predicted constraints. For details of the MTA procedure with an operative logic formulation of key steps in the CMT refer to Arsalidou, Pascual-Leone and Johnson (2010).