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Letter to the Editor Graphabulation: A graphic form of confabulation

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1. Introduction

Confabulation refers to "spontaneous 'narrative' reports of events that never happened" in patients with amnesia (Berlyne, 1972; Schacter et al., 1998). Falsification of stories is the main characteristic of confabulation, and the degree of confabulation is known to increase with a time delay after an event (Schnider, 2003; Schnider and Ptak, 1999). Despite abundant reports on verbal confabulation, little is known about the graphic version of confabulation, which can occur during the recall of figures that patients have seen or drawn. A few studies have reported rotation errors in reproducing the Rey–Osterrieth Complex Figure (RCFT) (Solms et al., 1998; Turnbull et al., 1997, 1995), and one of these also showed findings of irrelevant drawing (Solms et al., 1998), which may be a form of graphic confabulation. However, to our knowledge, no study has systemically evaluated graphic confabulation.

Recently, we examined a patient who has had profound confabulation for 18 years since the diagnosis of Wernicke– Korsakoff's syndrome. During delayed recall of the RCFT, she drew irrelevant figures (Fig. 1a). An experiment was conducted to test whether the nameable irrelevant objects in the figure represent a graphic form of confabulation (primary graphic confabulation) or simply represent drawings of what the patient had verbally confabulated (secondary graphic confabulation).

Assuming the patient's drawing of additional or irrelevant features as graphic confabulation, we quantified the degree of graphic confabulation using the number of strokes required to complete the figures. First, we posited that the amount of graphic confabulation would increase as a function of the time delay after copying. Second, we examined whether the number of strokes in the drawings was different for familiar versus unfamiliar figures. If the patient had secondary graphic confabulation, the patient would verbalize the familiar features, resulting in increased graphic confabulation. On the other hand, if the patient had primary graphic confabulation, the number of strokes to complete the figures would not differ between the familiar and unfamiliar figures.

2. Methods

2.1. Case description

A 53-year-old woman had been diagnosed with Wernicke– Korsakoff syndrome associated with hyperemesis gravidarum at the age of 35. Upon evaluation in our clinic, she was alert and cooperative but showed severe anterograde amnesia and remarkable confabulation. The contents of confabulation consisted of many different stories that she fabricated when asked, not spontaneously, and were inconsistent depending on situations. For instance, when asked about her daughter who had died 20 years before, she said "My daughter is in North Korea, working as a pediatric psychiatry doctor. She is married to the son of Mr. Kim Jung-il (the chairman of North Korea)". At other times, she said her daughter had been elected as a Miss Korea or was currently working at Soviet Russia.

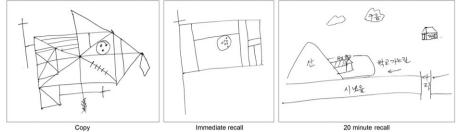
Detailed neuropsychological tests (Seoul Neuropsychological Screening Battery; Kang and Na, 2003) revealed profound amnesia and mild frontal executive dysfunction with attention, language, and visuospatial functions being unaffected [Seoul Verbal Learning Test: 22/36 in three free recall trials (85.9 percentile), but only 1/12 in the 20-min delayed recall (.01 percentile) confabulating 12 words with poor recognition; RCFT: poor immediate (6/36, 3.4 percentile) and 20-min delayed recall (0/36, 2.3 percentile) despite normal

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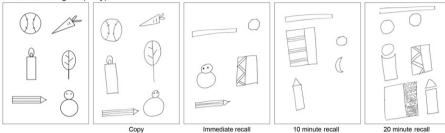
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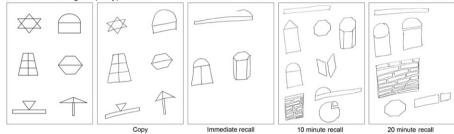




b Familiar Design B (easy)



C Unfamiliar Design B (easy)



d Familiar Design C (diffcult)

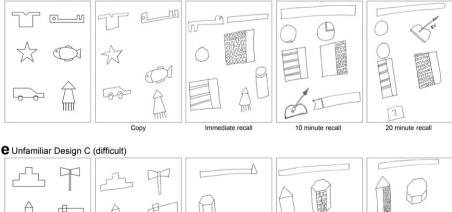




Fig. 1 – Patient's drawing of the RCFT, stimuli for the experiment, and the patient's responses. (a) Copy, immediate recall, and 20-min delayed recall of RCFT performed 18 years after the onset of Wernicke–Korsakoff syndrome. In the 20-min delayed recall, the patient drew figures irrelevant to the RCFT and also wrote Korean words to describe her figures, such as (from top to bottom and from left to right) "a cloud," "a village," "a mountain," "our school," "the way to school," "a river," and "a bridge." (b, c, d, e) Two sets of easy tasks (Familiar Design B and Unfamiliar Design B) and two sets of difficult tasks (Familiar Design C and Unfamiliar design C) are demonstrated. She copied well but began to draw irrelevant figures in the immediate recall tests. The number of strokes increased as the time delay increased from immediate to 20-min delayed recall in both familiar and unfamiliar conditions.

performance on copy (36/36); frontal executive functions: impaired in alternating hand movement test, fist-edge-palm test, color reading on the Stroop test (51/112, 6.1 percentile), and Controlled Oral Word Association Test (COWAT) on animal (9, 1.9 percentile) and supermarket items (11, 16.9 percentile) with normal performances on motor impersistence task, go-no-go test, and COWAT phonemic test (22, 41.7 percentile); attention: normal forward (9, 95.8 percentile) and backward (4, 59.9 percentile) digit span; and language tests: normal Boston Naming Test (44/60, 21.2 percentile)]. Conventional magnetic resonance imaging (MRI) revealed atrophy of the mammillary bodies and periaqueductal gray (not shown).

2.2. Experiment

The patient was asked to copy familiar or unfamiliar figures and then to recall them later. For the familiar design condition, the patient underwent four sets (two easy and two difficult) of stimuli, each comprising six familiar figures (typical examples from two sets in Fig. 1b and d). The easy versus difficult sets were discriminated by the number of strokes used to complete the drawing: 39 in the easy and 64 in the difficult set. For each set of familiar designs, the patient was instructed to copy all six figures and was then asked to recall the figures immediately, 10, and 20-min later. Tasks of unfamiliar design were performed in the same way except for using unfamiliar figures (typical examples from two sets in Fig. 1c and e). The order of the eight sets (four familiar and four unfamiliar) was randomized. Any straight line, circle, halfcircle, or separated dot was counted as one stroke. As control subjects, four female patients with amnestic mild cognitive impairment (aMCI) but without confabulation underwent parts of the tasks (Fig. 1 b-e) in the same way as the patient. Informed and written consent for participation was obtained from the patients, and the Institutional Review Board of the Samsung Medical Centre approved the protocol of this study.

3. Results

The patient's copying performance for all 48 figures (four sets of six familiar figures and four sets of six unfamiliar figures) was flawless. However, she recognizably drew 10/48 in the immediate recall, 5/48 in the 10-min delayed recall, and 4/48 in the 20-min delayed recall, with the number of strokes to draw each figure being increasing drastically as time delayed from copying to 20-min delayed recall (Supplementary Fig. 1, Patient). We performed repeated measures analysis of variance using Time (the four time conditions from copying to 20-min recall) and Familiarity or Time and Difficulty as the independent variables and using the total number of strokes/ set as the dependent variable. In Time and Familiarity analysis, the number of strokes increased according to Time [F (1.309, (3.927) = 16.164, p = .015] but not with Familiarity condition [F(1.000, 3.000) = .781, p = .442]. Similarly, in the Time and Difficulty analysis, the number of strokes increased with Time [F(3.000, 9.000) = 5.917, p = .016] but not with Difficulty [F(1.000, 9.000) = 5.917, p = .016]3.000) = 5.301, p = .105].

All control subjects showed profound impairment in memory recall with relative preservation of other cognitive functioning as did the patient of this study. Numbers of strokes (mean \pm SD) to complete drawing by aMCI control subjects are shown in Supplementary Fig. 2 and a typical performance of one control subject is shown in Supplementary Fig. 3. Unlike the patient, aMCI subjects showed decreased number of strokes to complete drawing figures in immediate ($n = 12.5 \pm 2.0$,) and 10- ($n = 2.4 \pm 1.1$) and 20-min delayed recall $(n = 5.7 \pm 3.2)$ conditions when compared with their copying performance ($n = 51.4 \pm 3.2$) (all p < .0001). There was no difference in number of strokes according to the Familiarity or Difficulty condition. Unlike the patient, however, aMCI patients showed a decrease in number of strokes according to Time (Supplementary Fig. 1, Control Subjects).

4. Discussion

In this study, we describe graphic confabulation in a patient with Wernicke-Korsakoff's syndrome based on three characteristics of the patient's drawings. First, the patient was able to perfectly copy figures but could recall few of the figures in immediate and delayed recall. Interestingly, the patient filled the memory gaps with irrelevant figures or similar figures using extra strokes. Second, the number of strokes required to draw the figures increased as a function of time delay which was not shown in control aMCI patients without confabulation. Third, there was no difference in the number of strokes between the familiar and unfamiliar tasks, which may exclude the possibility that she drew irrelevant figures that she verbally confabulated. The fact that the objects drawn during the recall conditions were often "abstract" also supports primary graphic confabulation.

In our patient's drawings, the same patterns tended to be repeated. However, the repetitive patterns were inconsistent with perseveration. The patterns only occurred during the immediate or delayed recalls and the amount increased with time delay. In addition, our patient did not make any perseverative errors on the Luria loop test or alternating square and triangle tests. Confabulation of grandiose stories by our patient may be inconsistent with a diagnosis of grandiose delusion. First, unlike grandiose delusion that is consistent and well-organized, the contents of our patient's grandiose stories changed according to the situation. Second, our patient did not show mania during the entire course of her disease, which is frequently combined in patients with grandiose delusion. Finally, our patient confabulated the grandiose stories when asked, but not spontaneously.

The drastic increase in the number of strokes during recall by the patient but not by control subjects suggests the existence of graphical confabulation which we name here as *graphabulation*. However, since the recall of the figures was poor both for the familiar and unfamiliar design conditions, we cannot completely exclude the possibility of secondary graphical confabulation caused by a floor effect of the task.

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Author contributions

R.J.H. and N.D.L. conceived and designed the study. R.J.H. designed tasks for graphical confabulation. R.J.H. and L.B.W. performed experiments. L.B.W., C.J. and K.G.H. recruited controls subjects. All of the authors discussed the results. R.J.H. wrote the manuscript with critical revision from N.D.L.

Supplementary material

Supplementary data related to this article can be found online at doi:10.1016/j.cortex.2011.05.004.

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