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Letter to the Editor

## Active participation in high fidelity simulation might be associated with higher stress level and better learning outcomes at three months than external observation

We have been very interested in the results reported by Blanié et al. [1]. In a randomised controlled trial, they compared learning outcomes – after a full-day high fidelity simulation (HFS) including four consecutive scenarios – between residents who had actively participated in one scenario and others who had only been observers from a separate room. Both active and observer residents were invited to take part to the debriefing following each scenario. Compared to observers, active participants had better results on medical knowledge score (sixteen multiples choice questions) immediately after the session. However, this difference did not persist over time since medical knowledge score was similar between the two groups three months after the HFS session.

In another recently published randomised controlled trial, we also studied residents' memory retention three months after a HFS session [2]. Sessions lasted half a day and included four or five consecutive anaesthesia-intensive care scenarios. A specific debriefing followed each scenario. The intervention was a 4-minute relaxation break inserted between the end of the scenario and the start of the debriefing. Debriefings were conducted according to plus/delta and Promoting Excellence and Reflective Learning in Simulation (PEARLS) models. At the end of each debriefing, five scenario-specific critical key messages (CKMs) were read aloud by the instructor. Each resident was active participant in one scenario and observer of other scenarios. For each resident as an observer, we focused on the observed scenario just following the one as active participant (in case of active participation in the last scenario, the observed scenario was the first one) Fig. 1. Demographics and psychometrics (including anxiety inventory and stress level) were collected at baseline and during the scenarios and related debriefings. Debriefing quality was assessed by active participants and observers using the Debriefing Assessment for Simulation Healthcare (DASH) tool. Three months later, each resident was asked by telephone to recall the five CKMs from both scenarios.

To increase our knowledge on this topic and to complete data obtained by Blanié et al., we used our data to conduct a post-hoc analysis in which levels of stress during the HFS session and memory retention at three months were compared between active participants and observers. All data have been pooled, regardless of the initial allocation group (relaxation or control). Data are expressed as n (proportion), mean (SD) or median [$25^{th}$–75th], as appropriate. Results were assessed using a Wilcoxon test for non-parametric data. A $P$-value $< 0.05$ was considered statistically significant.

Demographics and psychometrics of the 146 residents included are presented in Table 1. Mean debriefing duration was 29 (8) minutes. DASH Scores were not different between active participants and observers. Stress levels were constantly higher in active participants than in observers, until they became similar at the end of the debriefing. At three months, active participation was associated with a slightly better recall of CKM as compared with simple observation of the scenario ($P = 0.030$ with data distributions significantly different despite similar medians), Table 2. This result should be cautiously interpreted because the randomisation was not on learners' role but on relaxation. Moreover, active participants and observers had more than half CKM recalled for the memory retention test at three months. Although memory retention was only assessed through very simple open questions without baseline measurement, this suggests a sustained attention during scenarios and debriefings in all residents.

Several differences between the two studies have to be acknowledged. First, the structure of the HFS session might influence memory retention. The length of the simulation session (half-day vs. full-day) and the duration of each scenario and debriefing might have an impact on the learner's memory retention. On one hand, a concise and focused debriefing can help learners to concentrate on and better memorise pedagogical points of interest. On the other hand, a longer debriefing theoretically allows for more time to foster active participation from learners (including observers). The additional learning benefits of longer debriefings may not be demonstrated through a straightforward memory retention testing. Nevertheless, information overload may also distract learners from the primary pedagogical objectives of each scenario. To the best of our knowledge, no recommendation is available regarding the right amount of information to be provided during a debriefing, but complexity should be adapted to the learner's level [3]. Second, the number of active participants in a scenario can influence their perception of the importance of their own thinking, decision-making processes and resulting actions or inactions during the scenario. For instance, if multiple active participants are involved in a scenario, some may act as followers, disconnected from the essential accountability process that should be experienced by future front-line physicians (loss of leadership experience opportunities).

We also observed that active participants had higher stress levels than observers until the debriefing ended. Stress has various effects on learning and memorisation. Beyond a certain threshold, stress might impair selective attention, working memory and storage processes involved in memorisation [4]. The context and causal factors of stress might also explain the stress-related various effects [5]. We agree with Blanié et al. that complex links between stress level, memorisation and subsequent clinical performance should be deeply explored.

In conclusion, active participation in scenarios seems to provide some benefits over simple observation. On top of slightly better memory retention of CKM at three months, immersive active crisis management experience mobilizes human resources. This whole stressful management experience provides behavioural

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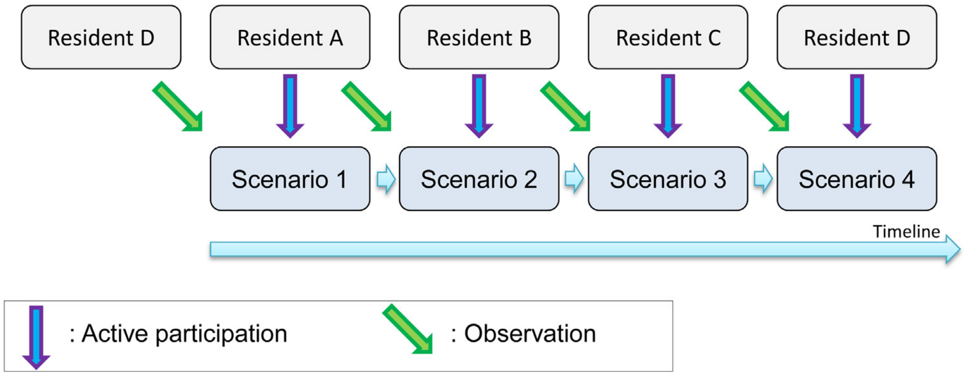


**Fig. 1.** Participation timeline of residents: active participants of a scenario and observers of another scenario.

**Table 1**
Resident characteristics at baseline.

| | |
|---|---|
| Demographic data | |
| Female, n (%) | 78 (52) |
| Age, years | 27 [26–28] |
| Psychometric data | |
| FNE, points | 17 (6) |
| STAI-T, points | 41 (8) |
| Initial STAI-S, points | 41 (10) |
| Initial VAS-S, mm | 45 (24) |

Values are expressed as *n* (%), mean (standard deviation) or median [25th–75th] as appropriate. FNE: fear of negative evaluation scale (from 0: no FNE to 30 points: FNE maximal). STAI: state-trait anxiety inventory (from 20: very low to 80 points: very high). STAI-S: STAI state. STAI-T: STAI trait. VAS-S: visual analog scale for stress (from 0: no stress to 100 mm: stress maximal).

**Table 2**
Outcome in active participants and observers.

| | Active participants (*n* = 146) | Observers (*n* = 145) | *P*-value |
|---|---|---|---|
| Psychometric data after assignment of the resident to the scenario | | | |
| Prior briefing VAS-S, mm | 62.5 [33–80] | 12 [2–27] | < 0.0001 |
| Prior scenario VAS-S, mm | 65 [41–83] | 14 [3–40] | < 0.0001 |
| Prior debriefing VAS-S, mm | 41 [27–61] | 14 [2–41] | < 0.0001 |
| Post debriefing VAS-S, mm | 11 [3–24] | 6 [1–21] | 0.098 |
| End of debriefing STAI-S, points | 33 [29–38] | 32 [27–40] | 0.989 |
| Debriefing | | | |
| DASH-Student, points | 38 [36–40] | 38 [36–40] | 0.362 |
| Evaluation at 3 months | | | |
| Number of CKM recalled | 3 [2–4] | 3 [2-3] | 0.030 |

Values are expressed as median [25th–75th]. STAI: state-trait anxiety inventory (from 20: very low to 80 points: very high). STAI-S: STAI state. VAS-S: visual analog scale for stress (from 0: no stress to 100 mm: stress maximal). DASH: debriefing assessment for simulation in healthcare (from 7: poor quality to 42 points: maximum quality). CKM: critical key messages (from 0 to 5).

experiences that might help future physicians to "build themselves". Nonetheless, given the current economic and organisational constraints surrounding simulation, the effects of active participation and external (but alert) observation on each level of learning including medical knowledge, technical skills, non-technical skills, stress management and metacognition deserve full attention and should be extensively explored.

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### Authors' contributions and authorship

M.L.: (1) conception and design of the study, acquisition of data, analysis and interpretation of data, (2) drafting the article, revising it critically for important intellectual content, (3) final approval of the version to be submitted.

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#### Disclosure of interest

The authors declare that they have no competing interest.

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