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RESEARCH

Replication Study of "Visual Fixation on the Thorax Predicts Bystander Breathing Detection in Simulated Out-of-Hospital Cardiac Arrest"

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ABSTRACT

Background: Early cardiopulmonary resuscitation (CPR) by lay responders is associated with improved survival from Out-of-Hospital Cardiac Arrest (OHCA). Recognition of OHCA, i.e., a victim who is unresponsive and not breathing, is essential to begin CPR as soon as possible. In 2022, we published a simulation study (Study 1; $n = 96$) which found that instructing lay responders to look at chest movement enables them to detect breathing. To expand the evidence and available data on this topic, we attempted a replication (Study 2; $n = 73$).

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Methods: Participants equipped with an eye tracker entered a room where a manikin, randomly set as breathing or unbreathing, laid on the floor. After the first simulation (pre-allocation), participants were randomly allocated to a video debriefing intervention with (experimental group) or without (control group) their recorded gaze overlay, in which they reviewed their thorax examination behavior. After debriefing, the simulation was repeated (post-allocation). The main outcome was success in detecting breathing.

Results: Study 2 was underpowered and failed to support the findings of Study 1. Pooling together the results of the two studies (n = 170) supports the findings of Study 1: Success rate at post-allocation did not differ between the experimental (83%) and the control group (80%), but it significantly increased from pre-allocation (65%) to post-allocation (81%; χ^2 = 10.88, p < .001). Each second spent examining the thorax increased the odds of success by 16% (OR = 1.16, 95% CI, 1.04–1.29). Median diagnosis time was 17.9 seconds (range = 2–119 seconds).

Conclusions: Educating lay responders on how to look for chest movement enhances breathing detection performance.

Keywords: replication; out-of-hospital cardiac arrest; simulation; breathing; cardiopulmonary resuscitation; eye movements

RÉSUMÉ

Contexte: La réanimation cardio-pulmonaire (RCP) pratiquée précocement par des témoins est associée à une amélioration des chances de survie en cas d'arrêt cardiaque extrahospitalier (OHCA). Il est essentiel de reconnaître l'OHCA, c'est-à-dire une victime inconsciente et qui ne respire pas, afin de commencer la RCP le plus tôt possible. En 2022, nous avons publié une étude de simulation (Étude 1 ; n = 96) qui a montré que le fait d'enseigner aux témoins à observer les mouvements du thorax leur permet de détecter la respiration. Afin d'élargir les preuves et les données disponibles à ce sujet, nous avons tenté de répliquer cette étude (Étude 2 ; n = 73).

Méthodes: Les participants équipés d'un eye tracker sont entrés dans une pièce où un mannequin – dont la respiration ou son absence avait été choisie au hasard – était allongé sur le sol. Après la première simulation (pré-allocation), les participants ont été répartis de manière aléatoire entre une intervention de débriefing vidéo avec (groupe expérimental) ou sans (groupe contrôle) la surimpression de leur regard, au cours de laquelle ils ont revu leur comportement d'examen du thorax. Après le débriefing, la simulation a été répétée (post-allocation). Le outcome principal était la détection de la respiration.

Résultats: L'Étude 2 manquait de puissance et n'a pas permis de confirmer les résultats de l'Étude 1. La mise en commun des résultats des deux études (n = 170) confirme les conclusions de l'Étude 1 : le taux de réussite à la post-allocation ne diffère pas entre le groupe expérimental (83%) et le groupe contrôle (80%), mais il augmente de manière significative entre la pré-allocation (65%) et la post-allocation (81% ; χ^2 = 10,88, p < .001). Chaque seconde passée à examiner le thorax augmentait les chances de succès de 16% (OR = 1,16, IC 95%, 1,04–1,29). La durée médiane du diagnostic était de 17,9 secondes (intervalle = 2–119 secondes).

Conclusions: Former les témoins à observer les mouvements du thorax améliore la détection de la respiration.

Mots-clés: réplication; arrêt cardiaque hors de l'hôpital; simulation; respiration; réanimation cardiopulmonaire; mouvements des yeux

MUHTASARI

Usuli: uhamshaji wa mapema wa mfumo wa moyo na mapafu (CPR) unaofanywa na watu wa kwanza unahusishwa na maisha bora kutoka kwa shambulio la Moyo yanayotokea Nje ya Hospitali (OHCA). Utambuzi wa OHCA, yaani, majeruhi aliyepoteza fahamu na hapumui, ni muhimu kuanza CPR haraka iwezekanavyo. Mnamo mwaka wa 2022, tulichapisha utafiti wa maigizo (Utafiti 1; n = 96) ambao uligundua kuwa watoa huduma kuangalia mwenendo wa kifua ili waweze kugundua majeruhi anapumua. Ili kupanua ushahidi na data inayopatikana juu ya mada hii, tulijaribu kurudia (Utafiti wa 2; n = 73).

Mbinu: Washiriki waliokuwa na kifaa cha kufuatilia macho walipoingia kwenye chumba ambamo midoli – iliyowekwa nasibu kama ya kupumua au isiyopumua – iliyokalazwa sakafuni. Baada ya uigizaji wa kwanza (mgao wa awali), washiriki waligawiwa kwa nasibu kwa uingiliaji wa mazungumzo ya video na (kikundi cha majaribio) au bila (kikundi cha kudhibiti) safu yao ya macho iliyorekodiwa, ambayo walikagua tabia yao ya uchunguzi wa kifua. Baada ya mazungumzo, jaribio ilirudiwa (baada ya ugawaji). Matokeo makuu yalikuwa ni mafanikio katika kugundua upumuaji.

Matokeo: Utafiti wa 2 haukuwa na uwezo wa kutosha na haukuweza kuunga mkono matokeo ya Utafiti wa 1. Kuunganisha pamoja matokeo ya tafiti mbili (n = 170) kunaunga mkono matokeo ya Utafiti wa 1: Kiwango cha kufaulu katika mgao wa baada ya kugawa hakikutofautiana kati ya majaribio (83%) na kikundi cha udhibiti (80%), lakini iliongezeka kwa kiasi kikubwa kutoka kwa mgao wa awali (65%) hadi baada ya mgao (81%; $\chi^2 = 10.88$, $p < .001$). Kila sekunde iliyotumiwa kuchunguza kifua iliongeza uwezekano wa kufaulu kwa 16% (OR = 1.16, 95% CI, 1.04–1.29). Muda wa utambuzi wa wastani ulikuwa sekunde 17.9 (safa = sekunde 2–119).

Hitimisho: Kuelimisha watoahuduma juu ya jinsi ya kuangalia harakati za kifua huongeza utendaji wa kutambua upumuaji.

Maneno Muhimu: kurudiwa; shambulio la moyo nje ya hospitali; kuiga; kupumua; kuamsha moyo na mapafu; harakati za macho

Out-of-hospital cardiac arrest (OHCA) is a major cause of death worldwide. Resuscitation guidelines recommend starting cardiopulmonary resuscitation (CPR) in an unresponsive person with absent or abnormal breathing (Olasveengen et al., 2021; Panchal et al., 2020). CPR consists of giving 30 chest compressions and 2 rescue breaths, as well as using a defibrillator as soon as one is available. Lay responders, the first people on the scene even before first-responder volunteers and emergency medical services, play an essential role in improving victims' survival conditions by initiating CPR. Survival with CPR in Europe is 9.1%, vs. 4.3% without CPR (Gräsner et al., 2020). Clinical outcomes improve, such as neurological status (Böttiger et al., 2020; Dainty et al., 2022; Kragholm et al., 2017) and survival rate (Böttiger et al., 2020; Dainty et al., 2022; Kragholm et al., 2017; Olasveengen et al., 2020; Wissenberg et al., 2013; Yan et al., 2020). Educating lay responders on how to detect the signs of sudden cardiac arrest is critical to increasing the survival rate (Dainty et al., 2022). Recent research in health care has employed simulation and eye tracking to obtain objective, measurable, quantitative data that have been used essentially for (a) providing an indication of students' and nurses' clinical skill and knowledge, (b) improving feedback and reflection during debriefings, and (c) developing new training solutions and measuring their efficacy (Ashraf et al., 2018). In the context of patient identification errors during medication administration – a potentially fatal situation – Marquard et al. (2011) found that error-identifying nurses tended to have an almost standardized and predictable eye fixation pattern across identifiers, while non-error-identifying nurses exhibited seemingly random patterns. In another simulated study on adverse drug events, 40% of nursing students administered amoxicillin to a patient with a documented allergy to penicillin: eye tracking allowed researchers to conclude that the students had correctly looked at enough information to identify the allergy, but they lacked sufficient pharmacological knowledge to prescribe an alternative (Amster et al., 2015). Henneman et al. (2014) compared classic simulation debriefing vs simulation debriefing with eye tracking. The latter included showing nursing students a video of their gaze behavior after the simulation. Certain patient safety practices improved significantly in the post-test: students in the eye tracking group exhibited better performance on tasks such as "compares stated allergies to allergy bracelet" and "compares patient's stated name with name on the ID band." Similar results have been suggested in the contexts of surgical training (O'Meara et al., 2015) and simulated medical emergencies (Szulewski et al., 2014). In another study, trainees provided with a supervisor's gaze trace while performing simulated laparoscopy made fewer errors and had faster completion time than colleagues in the control group (Chetwood et al., 2012). Causer et al. (2014) found that surgical residents, trained with eye tracking, maintained performance under high pressure better than traditionally trained counterparts. Other studies yielded results consistent with these findings (Litchfield & Ball, 2011; Vine et al., 2012). In 2022, we published a simulation study that showed that (1) instructing lay responders to look for chest movement enables them to detect breathing or lack thereof, (2) the more time spent looking at the chest of a victim with cardiac arrest, the greater the odds of detecting breathing or lack thereof, and (3) showing a person their recorded eye tracking gaze overlay during a video debriefing intervention does not enhance breathing detection at post-test (Pedrotti et al., 2022). These results have potential practical and useful implications for CPR training; however, results from one study cannot be considered conclusive, and we could not find other recent studies with these outcomes. Therefore, to expand the evidence and available data on this topic, we attempted a direct replication (Moreau & Wiebels, 2023) of that study, using the same methods.

METHODS

We followed the same procedure and materials detailed in Pedrotti et al. (2022). Here we provide a brief description of the methods. Prospective, blinded, single-center, 2-arm parallel randomized controlled trial with balanced randomization (1:1). We designed the trial to investigate the superiority of a novel intervention, specifically video debriefing with versus without eye-tracking gaze overlay. The procedure included a pre-allocation simulation, an intervention (video debriefing with or without gaze overlay), and a post-allocation simulation.

Eligibility criteria were:

1. Enrollment in the Healthcare Propaedeutic Year (HPY). The HPY provides healthcare theory, hands-on classes, and internships in healthcare institutions. Achievement of the HPY is mandatory to enroll in the Bachelor of Nursing program.
2. Achievement of the "Basic Life Support–Automated External Defibrillation–Swiss Resuscitation Council (BLS-AED-SRC)" certification during the HPY.

Participants equipped with an eye tracker entered a room where a manikin – randomly set as breathing or unbreathing – laid on the floor. The participant's task was to determine whether the victim needed CPR (for an unresponsive and unbreathing victim) or a recovery position (for an unresponsive and breathing victim) and to decide on the action to adopt. After the first simulation (pre-allocation), participants were randomly allocated to a video debriefing intervention with (experimental group) or without (control group) their recorded gaze overlay. During debriefing, the certified trainer focused on the thorax examination behavior of the participant previously filmed during pre-allocation. See Pedrotti et al. (2022) for more details on the debriefing procedure and script. After debriefing, they repeated the simulation (post-allocation). The primary outcome was success in detecting breathing, that is, the participant-initiated CPR on an unbreathing manikin, or placed a breathing manikin in a recovery position. The secondary outcome was thorax examination time, that is, the cumulative time spent looking at the manikin's chest (Figure 1). An experimenter conducted a blind review of the videos that the eye tracker camera filmed during the simulations to determine the time spent examining the thorax. Thorax viewing time was calculated by summing the time during the stay of the gaze crosshairs (see Figure 1A) between the clavicles and the umbilicus. Sometimes, participants held their cheeks to the upper part of the manikin's chest to obtain an oblique view of the thorax, a position too close to the target for the eye-tracking system to estimate the gaze point correctly. In this case, we recorded the time the participant remained in this position as thorax examination time.

We made no substantial changes to the method either in the prelude or after the trial began. The study was carried out in Switzerland, on campus at the Delémont and Neuchâtel sites of the Haute École Arc. We recruited participants using internal e-mail lists. We filed the study protocol with Swissethics, which confirmed that the study did not fall within the scope of the Federal Law on Research on Human Beings (The Federal Assembly of the Swiss Confederation, 2011). We conducted the study in compliance with the Federal Law on Data Protection (The Federal Assembly of the Swiss Confederation, 1992) and every participant signed an informed consent form. Voluntary participants received financial compensation of 30 Swiss francs.

Statistical Methods

We tested the change in success rate (i.e., the ratio of the number of successes to the number of participants) from pre-allocation to post-allocation using a McNemar test (Lachenbruch, 2014). We assessed associations between groups (experimental vs. control), thorax examination time, and success rate by logistic regression. The dependent variable was success rate (binary variable, success = 1); the independent variables were group (experimental = 1) and thorax examination time (in seconds).

We computed the sample size using G*Power 3.1 (Faul et al., 2009). Input parameters were: 1-tailed, moderate effect size (d = .5), α = .05, $1 - \beta$ = .8, allocation ratio = 1. This resulted in 102 required participants, i.e. 51 participants for each group.

RESULTS

We henceforth refer to the original study as "Study 1" (Pedrotti et al., 2022) and the current study as "Study 2". For Study 2, recruitment, pre-allocation, and post-allocation simulations took place between October 2021 and February 2022. Follow-up simulations did not take place because we were unable to re-recruit participants. Of the 144 students enrolled, 84 agreed to participate in the study, and 11 participants could not complete or even begin the study because of technical problems with eye tracking (i.e., the impossibility of performing a calibration or even detecting the pupil), see Figure 2. This represents a 13.1% data loss. All the data are available as supplementary materials of the current article.

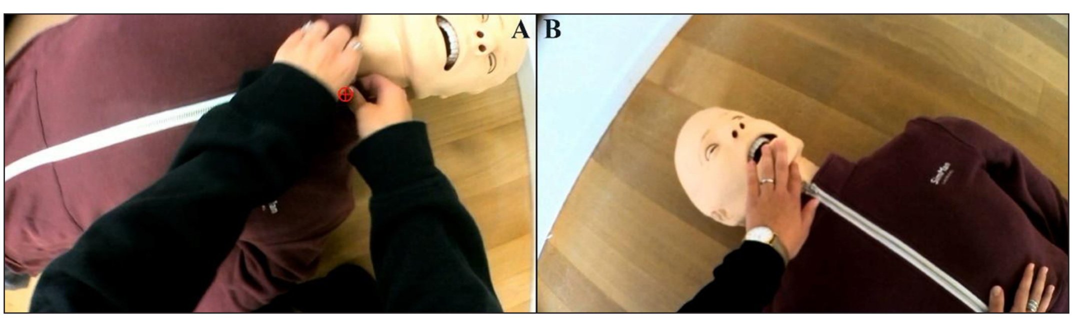

Figure 1: Thorax examination.

Note: A. Intervention. Participants who received the intervention (experimental group) underwent video debriefing with gaze overlay (left image). The encircled red cross on the participant's thumb represents the participant's gaze point. **B.** Participants who did not receive the intervention (control group) underwent video debriefing without gaze overlay (right image). For both groups, during the pre-allocation simulation, we used the camera on the head-mounted eye tracker to film the video recordings shown during the debriefing.

Ultimately, 73 participants received the intervention, and we analyzed their data for the primary outcome (success rate). For the secondary outcome (thorax examination time), we obtained valid data only for 52 participants because of poor eye-tracking recording quality. Table 1 contains the participants' baseline demographics. For all participants, this study was their first experience with simulation.

There was no significant difference in the success rate between both groups at post-allocation (experimental = 89%, control = 78%, p = .197). At pre-allocation,

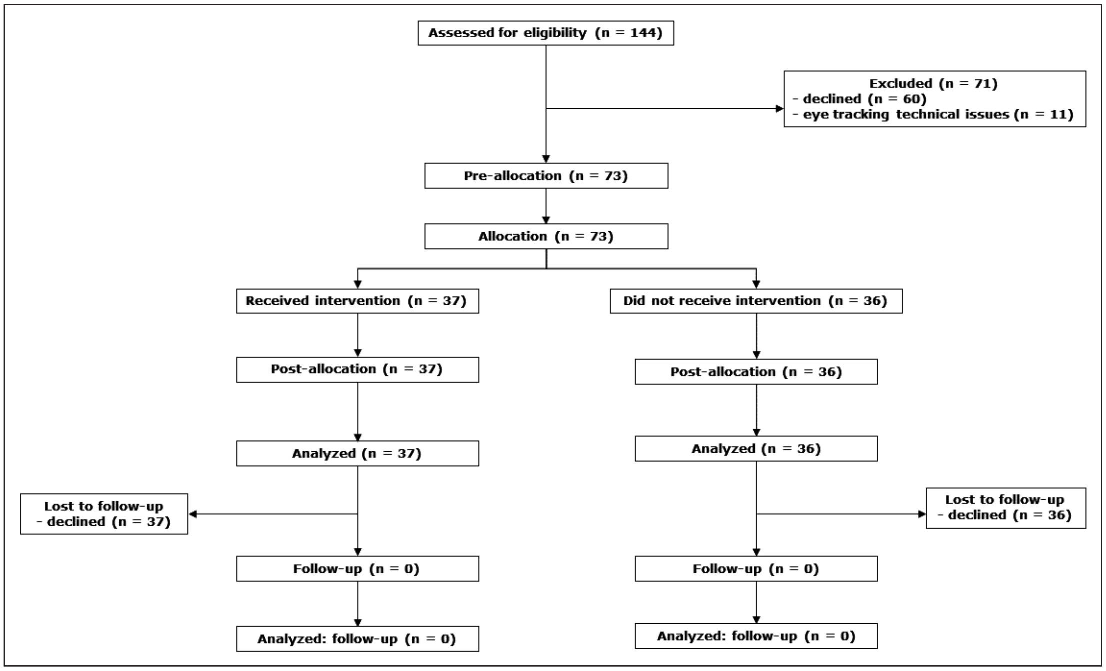

Figure 2: Flow Diagram of the Study Participants.

Demographic data	**Group**				***t*(71)**	***p***	**Cohen's *d***
	Experimental		**Control**				
	M	***SD***	***M***	***SD***			
Age (years)	21.3	3.2	21.4	6.2	–0.08	.936	0.02
Height (meters)	1.7	0.1	1.7	0.1	0.53	.595	0
Weight (kg)	65.8	9.1	61.4	9.6	1.96	.053	0.47
	n	**%**	***n***	**%**			
Gender							
Female	27	37	29	40			
Male	46	63	44	60			
Corrective glasses or lenses							
Yes	22	30	30	22			
No	51	70	70	78			
First aid course for driver's license							
Yes	32	44	34	47			
No	41	56	39	53			

Table 1: The Participants' Baseline Demographics.

Note: The data are expressed in numbers (*n*), percentages (%), means (*M*), and standard deviations (*SD*).

53 of the 73 participants made the right choice, (73% success rate), statistically different from 50% (z = 3.86, p < .001). Following debriefing, at post-allocation, 61 of the 73 participants made the right choice (84% success rate), significantly greater than 50% (z = 5.74, p < .001). McNemar's test showed that the increase in success rate from pre-allocation (73%) to post-allocation (84%) was not significant (χ^2 = 2.90, p = .090; Table 2).

We assessed associations between thorax examination time and success rate by logistic regression. We conducted this analysis on 52 participants because we lost 21 gaze recordings due to technical issues with the eye-tracking software at pre-allocation, post-allocation, or both. During pre-allocation, logistic regression did not show any association between thorax-examination time and success rate (χ^2 vs. constant model: 1.40, p = .237, as depicted in Table 3). Following debriefing, logistic regression on post-allocation did not show a significant association between thorax examination time and success rate (χ^2 vs. constant model: 1.85, p = .390, as shown in Table 3). Mean thorax gaze duration significantly increased by 5.40 seconds (95% CI, 3.69–7.12) from pre-allocation (4.88 seconds, SD = 3.77) to post-allocation (10.29 seconds, SD = 5.3); see Figure 3. We did not conduct any ancillary analyses. The participants did not encounter any harm or unintended effects.

When we pooled the results of Study 1 and Study 2, the experimental group did not have a significantly higher success rate at post-allocation than the control group (experimental = 83%; control = 80%; χ^2 vs constant model: 0.69, p = .70); Examination of the logistic regression coefficients showed no difference between Study 1 and

	Study 1			**Study 2**			**Study 1 + Study 2**		
	n			***n***			***n***		
	97			**73**			**170**		
	success	***z***	***p***	**success**	***z***	***p***	**success**	***z***	***p***
Pre-allocation	59%	1.62	.100	73%	3.86	.000	65%	3.83	.000
Post-allocation	79%	5.69	.000	84%	5.74	.000	81%	8.12	.000
	χ^2		***p***	χ^2		***p***	χ^2		***p***
Pre-allocation vs Post-allocation	7.22		.010	2.90		.090	10.88		.000

Table 2: Primary outcome: Success Rate.

Note: Success is defined as the participant initiating CPR on an unbreathing manikin or placing a breathing manikin in a recovery position.

z scores refer to the results of the z-test comparing the observed frequencies versus chance level (50%). χ^2 refers to the results of McNemar's test comparing frequencies at pre-allocation versus post-allocation.

	Study 1		**Study 2**		**Study 1 + Study 2**	
	n		***n***		***n***	
	97		**73**		**170**	
	χ^2	***p***	χ^2	***p***	χ^2	***p***
Pre-allocation	0.15	.690	1.40	.237	3.17	.205
Post-allocation	16.50	.000	1.85	.390	10.00	.019

Table 3: Association Between Thorax Examination Time and Success Rate.

Note: χ^2 refers to the results of logistic regression assessing the association between time spent examining the thorax and success rate. The dependent variable is the success rate (binary variable, success = 1); the independent variable is time spent examining the thorax (seconds).

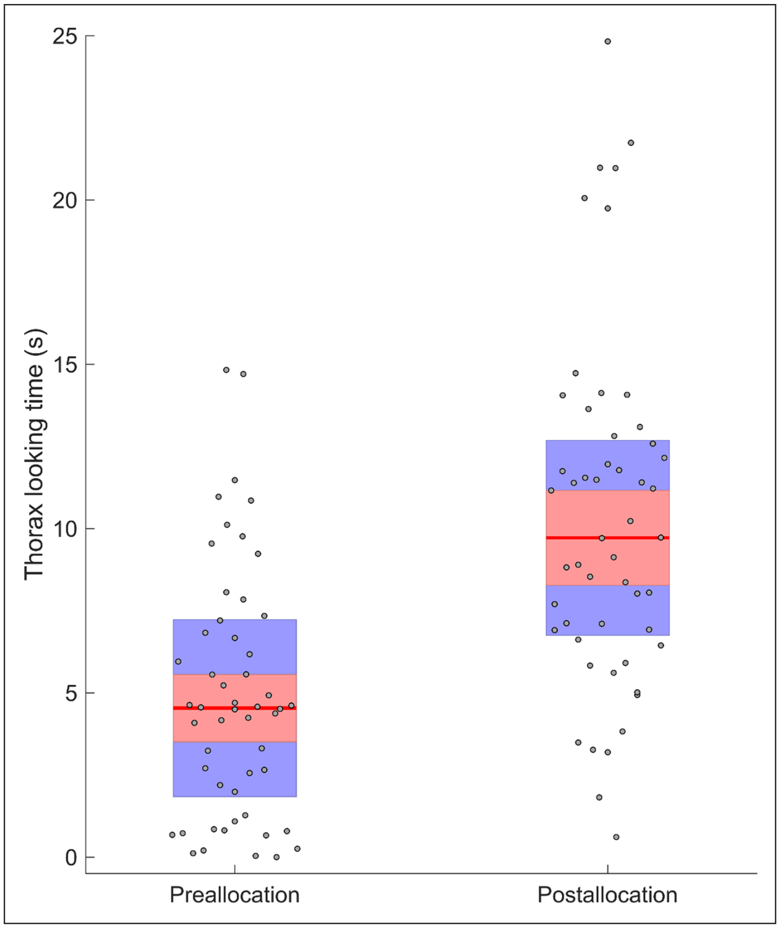

Figure 3 Study 2: Thorax Examination Time During Pre-allocation and Post-allocation.

Note: Each dot represents one participant. Red lines are medians with 95% CI (shaded red boxes). Blue boxes are 25 and 75 percentiles (n = 52).

Study 2). At pre-allocation, 110 of the 170 participants made the right choice (65% success rate), statistically different from 50% (z = 3.83, p < .001): success rate at pre-allocation was greater than chance. Following debriefing, at post-allocation, 138 of the 170 participants made the right choice (81% success rate), significantly greater than 50% (z = 8.12, p < .001). McNemar's test showed that the 16% increase in success rate from pre-allocation (65%) to post-allocation (81%) was significant (χ^2 = 10.88, p < .001; see Table 2). During pre-allocation, logistic regression did not show any association between thorax-examination time and success rate (χ^2 vs constant model: 3.17, p = .205). At post-allocation, following debriefing, logistic regression showed a significant association between thorax examination time and success rate (χ^2 vs constant model: 10.00, p = .019; see Table 3). The analysis of the regression parameters showed that there is an association between the time spent examining the thorax and the success rate: the more time spent looking at the thorax, the greater the odds of making the right decision (OR = 1.16, 95% CI, 1.04–1.29): each second spent examining the thorax increased the odds of success by 16%. Consistently, mean thorax gaze duration significantly increased by 5.76 seconds (95% CI, 4.72–6.80) from pre-allocation (3.96 seconds, SD = 4.07) to post-allocation (9.72 seconds, SD = 5.75).

DISCUSSION

The pattern of results suggests that Study 2 was underpowered and therefore failed to replicate all the findings of Study 1 because we could recruit only 73 participants for Study 2 versus 97 participants for Study 1, which was almost the theoretical 102 participants necessary per the *a priori* power analysis (see the Statistical Methods section). This is reinforced by the fact that pooling the results of the two studies yields the results of the original study (Study 1). Based on the results of the two studies (*n* = 170), it is safe to assume the following:

1. **Instructing lay rescuers to look for chest movement enables them to detect breathing.**
   At pre-allocation, without any instruction, 110 of the 170 participants (65%) could correctly identify the breathing status and take appropriate action (i.e., start CPR on an unresponsive and non-breathing victim). At post-allocation, after being instructed to look at chest movement, 138 of the 170 participants (81%) succeeded in detecting breathing and acted accordingly. The 16% increase is statistically significant and practically relevant, in that lay rescuers could recognize 16% more OHCAs.
2. **The more time spent examining a cardiac arrest victim's chest, the greater the odds of detecting breathing.**
   The logistic regression analysis revealed that each additional second spent examining the thorax increased the odds of correctly identifying the breathing by 16% as compared to cases of misidentification (odds ratio). This is practically relevant because it shows an association between an observable and transmissible behavior (looking at the chest) and a critical outcome (detecting breathing or its absence).
3. **Showing a person their recorded gaze overlay during a video debriefing intervention does not enhance breathing detection.**
   The experimental group did not exhibit a significantly higher success rate at post-allocation (83%) than the control group (85%). This RCT confirms that video debriefing is already effective for learning purposes, and the cost/benefit ratio of adding an eye-tracking video overlay is low considering the time and resources needed. Other studies found that showing nurses, physicians, or surgeon students the video of their gaze behavior improved performance in several tasks (Henneman et al., 2014; O'Meara et al., 2015; Szulewski & Howes, 2014); however, the methods were different from the current study, in that they were not RCT targeted at assessing the benefit of gaze overlay during video debriefing.

Considering all trials (Study 1 + Study 2), the median diagnosis (breaths yes/no) time was 17.9 seconds (range = 2–119 seconds), slightly higher than Ruppert et al. (1999), who reported 15.5 seconds (range = 2–63 seconds;). This suggests that lay rescuers likely need more than the 10 seconds currently recommended for the "check breathing" step of CPR resuscitation guidelines.

Limitations

One limitation of a broader generalization is that our participants were prospective students of a bachelor's degree program in nursing who had already completed CPR training, and most of them (89%) had taken a first aid course as part of their driver's license issuance procedure. We speculate that correct breathing recognition at pre-allocation could be lower than 65% in the general population and that the improvement at post-allocation could then be higher than 16%; however, further data is needed to demonstrate this.

Another barrier to broader generalization is that we used manikins to simulate OHCA victims. Even though they are high-fidelity manikins, they cannot imitate critical events, such as gasping and agonal breathing. Moreover, we miss the "feel" part of the "Look, listen, and feel" CPR recommendation, because our manikin does not exhale air from the mouth/nose when simulating breathing, it only makes the chest rise/fall and breathing noises.

CONCLUSION

OHCA is a leading cause of death worldwide. Lay rescuers can have an impact on survival if they recognize OHCA early enough in an unresponsive and unbreathing person. We simulated this situation with 170 participants using manikins as victims. The results of Study 1 and Study 2 show that instructing lay rescuers to look for chest movement enhances breathing detection performance.

Participants could correctly detect breathing (or its absence) up to 81% of the time. The more time spent examining a cardiac arrest victim's chest, the greater the odds of detecting breathing. We therefore recommend that CPR trainers stress the importance of visually examining the thorax as part of the "Look, listen, and feel" routine for the recognition of OHCA.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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REFERENCES

Ashraf, H., Sodergren, M. H., Merali, N., Mylonas, G., Singh, H., & **Darzi, A.** (2018). Eye-tracking Technology in Medical Education: A Systematic Review. *Medical teacher*, *40*(1), 62–69. DOI: https://doi.org/10.1080/0142159X.2017.1391373

Amster, B., Marquard, J., Henneman, E., & **Fisher, D.** (2015). Using an Eye Tracker During Medication Administration to Identify Gaps in Nursing Students' Contextual Knowledge: An Observational Study. *Nurse Educator*, *40*(2), 83–86. DOI: https://doi.org/10.1097/NNE.0000000000000097

Böttiger, B. W., Becker, L. B., Kern, K. B., Lippert, F., Lockey, A., Ristagno, G., Semeraro, F., & **Wingen, S.** (2020). BIG FIVE Strategies for Survival Following Out-of-Hospital Cardiac Arrest. *European Journal of Anaesthesiology*, *37*(11), 955. DOI: https://doi.org/10.1097/EJA.0000000000001247

Causer, J., Vickers, J. N., Snelgrove, R., Arsenault, G., & **Harvey, A.** (2014). Performing Under Pressure: Quiet Eye Training Improves Surgical Knot-tying Performance. *Surgery*, *156*(5), 1089–1096. DOI: https://doi.org/10.1016/j.surg.2014.05.004

Chetwood, A. S., Kwok, K. W., Sun, L. W., Mylonas, G. P., Clark, J., Darzi, A., & **Yang, G. Z.** (2012). Collaborative Eye Tracking: A Potential Training Tool in Laparoscopic Surgery. *Surgical endoscopy*, *26*, 2003–2009. DOI: https://doi.org/10.1007/s00464-011-2143-x

Dainty, K. N., Brianna Colquitt, C., Bhanji, F., Hunt, E. A., Jefkins, T., Leary, M., Ornato, J. P., Swor, R. A., & **Panchal, A.** (2022). Understanding the Importance of the Lay Responder Experience in Out-of-Hospital Cardiac Arrest: A Scientific Statement From the American Heart Association. *Circulation*, *145*(17), E852–E867. DOI: https://doi.org/10.1161/CIR.0000000000001054

Faul, F., Erdfelder, E., Buchner, A., & **Lang, A. G.** (2009). Statistical Power Analyses Using G* Power 3.1: Tests for Correlation and Regression Analyses. *Behavior Research Methods*, *41*(4), 1149–1160. DOI: https://doi.org/10.3758/BRM.41.4.1149

Gräsner, J. T., Wnent, J., Herlitz, J., Perkins, G. D., Lefering, R., Tjelmeland, I., Koster, R. W., Masterson, S., Rossell-Ortiz, F., Maurer, H., Böttiger, B. W., Moertl, M., Mols, P., Alihodžić, H., Hadžibegović, I., Ioannides, M., Truhlář, A., Wissenberg, M., Salo, A., … Bossaert, L. (2020). Survival After Out-of-Hospital Cardiac Arrest in Europe – Results of the EuReCa TWO Study. Resuscitation, 148, 218–226. DOI: https://doi.org/10.1016/j.resuscitation.2019.12.042

Henneman, E. A., Cunningham, H., Fisher, D. L., Plotkin, K., Nathanson, B. H., Roche, J. P., Marquard, J. L., Reilly, C. A., & **Henneman, P. L.** (2014). Eye Tracking as a Debriefing Mechanism in the Simulated Setting Improves Patient Safety Practices. *Dimensions of Critical Care Nursing*, *33*(3), 129–135. DOI: https://doi.org/10.1097/DCC.0000000000000041

Kragholm, K., Wissenberg, M., Mortensen, R. N., Hansen, S. M., Malta Hansen, C., Thorsteinsson, K., Rajan, S., Lippert, F., Folke, F., Gislason, G., Køber, L., Fonager, K., Jensen, S. E., Gerds, T. A., Torp-Pedersen, C., & **Rasmussen, B. S.** (2017). Bystander Efforts and 1-Year Outcomes in Out-of-Hospital Cardiac Arrest. *N Engl J Med*, *376*(18), 1737–1747. DOI: https://doi.org/10.1056/NEJMoa1601891

Lachenbruch, P.A. (2014). McNemar test. In: Balakrishnan, N., Colton, T., Everitt, B., Piegorsch, W., Ruggeri, F., Teugels, J.L., (Eds.). *Wiley StatsRef: Statistics Reference Online*. DOI: https://doi.org/10.1002/9781118445112.stat04876

Litchfield, D., & **Ball, L. J.** (2011). Rapid Communication: Using Another's Gaze As an Explicit Aid to Insight Problem Solving. *Quarterly Journal of Experimental Psychology*, *64*(4), 649–656. DOI: https://doi.org/10.1080/17470218.2011.558628

Marquard, J. L., Henneman, P. L., He, Z., Jo, J., Fisher, D. L., & **Henneman, E. A.** (2011). Nurses' Behaviors and Visual Scanning Patterns May Reduce Patient Identification Errors. *Journal of Experimental Psychology: Applied*, *17*(3), 247–256. DOI: https://doi.org/10.1037/a0025261

Moreau, D., & **Wiebels, K.** (2023). Ten Simple Rules for Designing and Conducting Undergraduate Replication Projects. *PLOS Computational Biology*, *19*(3), e1010957. DOI: https://doi.org/10.1371/journal.pcbi.1010957

Olasveengen, T. M., Mancini, M. E., Perkins, G. D., Avis, S., Brooks, S., Castrén, M., Chung, S. P., Considine, J., Couper, K., Escalante, R., Hatanaka, T., Hung, K. K. C., Kudenchuk, P., Lim, S. H., Nishiyama, C., Ristagno, G., Semeraro, F., Smith, C. M., Smyth, M. A., … Morley, P. T. (2020). Adult Basic Life Support: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. *Circulation*, *142*(16 1), S41–S91. DOI: https://doi.org/10.1161/CIR.0000000000000892

Olasveengen, T. M., Semeraro, F., Ristagno, G., Castren, M., Handley, A., Kuzovlev, A., Monsieurs, K.G., Raffay, V., Smyth, M., Soar, J, Svavarsdottir, H., Perkins. (2021). European Resuscitation Council Guidelines 2021: Basic Life Support. *Resuscitation*, *161*, 98–114. DOI: https://doi.org/10.1016/j.resuscitation.2021.02.009

O'Meara, P., Munro, G., Williams, B., Cooper, S., Bogossian, F., Ross, L., Sparkes, L., Browning, M., & **McClounan, M.** (2015). Developing Situation Awareness Amongst Nursing and Paramedicine Students Utilizing Eye Tracking Technology and Video Debriefing Techniques: A Proof of Concept Paper. *International Emergency Nursing*, *23*(2), 94–99. DOI: https://doi.org/10.1016/j.ienj.2014.11.001

Panchal, A. R., Bartos, J. A., Cabañas, J. G., Donnino, M. W., Drennan, I. R., Hirsch, K. G., … & **Berg, K. M.** (2020). Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*, *142*(16_Suppl_2), S366–S468. DOI: https://doi.org/10.1161/CIR.0000000000000916

Pedrotti, M., Terrier, P., Gelin, L., Stanek, M., & **Schirlin, O.** (2022). Visual Fixation on the Thorax Predicts Bystander Breathing Detection in Simulated

Out-of-Hospital Cardiac Arrest, but Video Debriefing with Eye Tracking Gaze Overlay Does Not Enhance Postallocation Success Rate: A Randomized Controlled Trial. *Simulation in Healthcare*, *17*(6), 377–384. DOI: https://doi.org/10.1097/SIH.0000000000000617

Ruppert, M., Reith, M. W., Widmann, J. H., Lackner, C. K., Kerkmann, R., Schweiberer, L., & **Peter, K.** (1999). Checking for Breathing: Evaluation of the Diagnostic Capability of Emergency Medical Services Personnel, Physicians, Medical Students, and Medical Laypersons. *Annals of Emergency Medicine*, *34*(6), 720–729. DOI: https://doi.org/10.1016/S0196-0644(99)70097-1

Szulewski, A., & **Howes, D.** (2014). Combining First-person Video and Gaze-Tracking in Medical Simulation: A Technical Feasibility Study. *The Scientific World Journal*, *2014*. DOI: https://doi.org/10.1155/2014/975752

The Federal Assembly of the Swiss Confederation. (1992). *Federal Act on Data Protection*. https://www.fedlex.admin.ch/eli/cc/1993/1945_1945_1945/en

The Federal Assembly of the Swiss Confederation. (2011). *Federal Act on Research Involving Human Beings*. https://www.fedlex.admin.ch/eli/cc/2013/617/en

Vine, S. J., Masters, R. S., McGrath, J. S., Bright, E., & **Wilson, M. R.** (2012). Cheating Experience: Guiding Novices to Adopt the Gaze Strategies of Experts Expedites the Learning of Technical Laparoscopic Skills. *Surgery*, *152*(1), 32–40. DOI: https://doi.org/10.1016/j.surg.2012.02.002

Wissenberg, M., Lippert, F. K., Folke, F., Weeke, P., Hansen, C. M., Christensen, E. F., Jans, H., Hansen, P. A., Lang-Jensen, T., Olesen, J. B., Lindhardsen, J., Fosbol, E. L., Nielsen, S. L., Gislason, G. H., Kober, L., & **Torp-Pedersen, C.** (2013). Association of National Initiatives to Improve Cardiac Arrest Management With Rates of Bystander Intervention and Patient Survival After Out-of-Hospital Cardiac Arrest. *JAMA*, *310*(13), 1377–1384. DOI: https://doi.org/10.1001/jama.2013.278483

Yan, S., Gan, Y., Jiang, N., Wang, R., Chen, Y., Luo, Z., Zong, Q., Chen, S., & **Lv, C.** (2020). The Global Survival Rate Among Adult Out-of-Hospital Cardiac Arrest Patients Who Received Cardiopulmonary Resuscitation: A Systematic Review and Meta-Analysis. *Critical Care*, *24*(1), 1–13. DOI: https://doi.org/10.1186/s13054-020-2773-2