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ORIGINAL ARTICLE

# Evaluating the Effects of Popular Music on Cardiopulmonary Resuscitation Training in Nursing Students: A Randomized Controlled Study

## Hemşirelik Öğrencilerinde Popüler Müziğin Kardiyopulmoner Resüsitasyon Eğitimi Üzerindeki Etkilerinin Değerlendirilmesi: Randomize Kontrollü Bir Çalışma

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### Abstract

**Objective:** This study aimed to analyze the short- and long-term effects of musical memory created using a national popular song on achieving the recommended compression rate, depth, and compression-breath rate for nursing students who received cardiopulmonary resuscitation (CPR) training.

**Method:** This study had an experimental, randomized posttest control group design. The study was conducted between February and June 2018 on 49 third-year nursing students who received CPR training for the first time. The control group received standard CPR training, whereas the intervention group received CPR training using a nationally popular song. The study evaluated compression rate and depth, satisfaction with CPR training, and arm pain during CPR. Data were collected immediately after CPR training (short-term) and six weeks after training (long-term).

**Results:** The differences between the control and intervention groups regarding the correct and incorrect breath rates were not statistically significant ($p>0.05$). In addition, there was no significant difference between the control and intervention groups in terms of compression and breathing rates measured six weeks after CPR training was not statistically ($p>0.05$). Satisfaction with CPR training was higher in the control group.

**Conclusion:** Although existing studies suggested that popular music is an effective tool for achieving the recommended compression rate, this study did not find any significant impact of popular national music on chest compression performance. Trial Registration: clinicaltrials.gov; Identifier: NCT06557109

**Keywords:** Cardiopulmonary resuscitation, training methods, music, nursing students

### Öz

**Amaç:** Bu çalışmanın amacı, ulusal popüler müzik kullanılarak oluşturulan müzikal hafıza ritminin, kardiyopulmoner resüsitasyondaki (KPR) solunum sayısı, göğüs kompresyonu sayısı ve derinliği üzerine kısa ve uzun dönemdeki etkisinin incelenmesidir.

**Yöntem:** Araştırma, deneysel, randomize, son test kontrol gruplu araştırma tasarımına uygun yapıldı. Araştırma, ilk kez KPR eğitimi alan 49 hemşirelik okulu üçüncü sınıf öğrencisi ile Şubat-Haziran 2018 arasında yürütüldü. Girişim grubuna yerel müzik ile, kontrol grubuna standart KPR eğitimi uygulandı. Araştırmada; göğüs basısı sayısı, derinliği, KPR eğitimine yönelik memnuniyet, CPR uygulaması sırasında kol ağrısı değerlendirildi. Veriler, KPR eğitimi sonrası (kısa dönem) ve eğitimden altı hafta sonra (uzun dönem) olmak üzere toplandı.

**Bulgular:** Eğitim sonrası ilk değerlendirmede, müdahale ve kontrol grubu arasında doğru kompresyon hızı ve yanlış solunum hızı sayıları arasında anlamlı farklılık saptanmadı ($p>0,05$). Eğitimden altı hafta sonraki değerlendirmede müdahale ve kontrol grupları arasında kompresyon ve solunum hızı sayıları arasında fark bulunmadı ($p>0,05$). KPR eğitiminden memnuniyet düzeyi kontrol grubunda daha yüksek saptandı.

**Sonuç:** Mevcut çalışmalarda, popüler müzik kullanımının önerilen kompresyon oranını elde etmek için etkili bir araç olduğu belirtilse de, bu çalışma da, ulusal popüler müziğin göğüs kompresyonları performansı üzerinde önemli bir etkisi bulunmadı. Trial Registration: clinicaltrials.gov. No: NCT06557109

**Anahtar Kelimeler:** Kardiyopulmoner resisütasyon, eğitim yöntemleri, müzik, hemşirelik öğrencileri

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## Introduction

The incidence of out-of-hospital cardiac arrest has increased in parallel with an increase in the prevalence of coronary artery disease. Cardiopulmonary resuscitation (CPR) after out-of-hospital cardiac arrest decreases mortality rates and triples discharge rates (1,2). Effective and high-quality CPR before and at the hospital has positive effects on patient outcomes and the return of spontaneous circulation (3,4). Patient survival and CPR effectiveness depend on the optimal rate and depth of chest compression (5-9).

Nursing education aims to prepare students with the knowledge, skills, and attitudes necessary to provide quality patient care in the future (10). CPR training is one of the most basic skills that a nursing student must be trained in. Nurses are the first responders to initiate CPR on a patient during cardiac arrest in the clinic. Therefore, effective CPR training of nursing students and ensuring the quality of nursing education are vital for students to fulfill their roles in the future (11). Effective CPR training includes correct hand position, compression rate and depth, and chest wall recoil (12). Considering that traditional teaching methods have limited effectiveness in terms of learning and training management, it may be beneficial to use innovative methods in CPR training (12). Music therapy is recommended for effective CPR training as a tool to learn the CPR compression rate, to help remember the rate, and to adjust the rate of actual compression (12,13).

The American Heart Association (AHA) Guidelines for Basic Life Support and CPR recommended that rescuers perform CPR chest compression at a rate of 100-120/min and to a depth of at least 5 cm while avoiding chest compression depth >6 cm (14). Different methods, including the music tempo, have been used to achieve the optimal compression rate. Popular songs with at least 100 beats/min, such as, “Stayin Alive”, “Nellie the Elephant”, and “Macarena” are chosen to perform the recommended compression rate (15,16). Since the rhythm and emphasis of these songs are constant, they are easy to remember and may be used as mental metronomes to perform the optimal compression rate during CPR training (17-19).

Clinical guidelines recommend using popular music as a mental metronome during the CPR training (20,21) However, the songs recommended by the AHA are not popular in all countries. Rescuers may find it difficult to remember the rhythm of these songs. For this reason, we used a popular Turkish song, entitled, “Senden Daha Güzel” and performed by Duman, to create a musical memory to be used as a mental metronome and analyzed the short- and long-term effects of using popular national songs on achieving recommended compression rate, depth, and compression-breath rate for nursing students who received CPR training and performed CPR on high-fidelity simulation mannequins for the first time.

**Main Points**

- The effectiveness of cardiopulmonary resuscitation (CPR) depends on the optimal rate and depth of chest compression.
- Clinical guidelines recommended using popular music as a mental metronome during the CPR training.
- There is no study that used a popular Turkish song to impact musical memory on CPR performance.

## Material and Method

### Study Design and Setting

This study had an experimental, randomized posttest control group design. This research was conducted at the Department of Nursing at the Eastern Mediterranean University, Faculty of Health Sciences between February and June 2018.

### Sample Size and Randomization

The study population comprised 70 third-year nursing students who were enrolled in the nursing department of the faculty of health sciences at East Mediterranean University in the spring semester of the 2017-18 academic year and who did not receive prior CPR training. The sample size was calculated using G*Power software (version 3.1.9.2). Tastan et al. (17) on the impact of music on cardiac resuscitation found that the chest compression rates for the intervention and control groups were 107.33±7.29/min and 121.47±12.91/min, respectively. Based on these findings, the effect size was d=1.35. The sample of the study was calculated as 26 for 95% power, 95% confidence interval, and d=1.35 effect size with 13 participants in the experimental and control groups. 14 students that did not agree to participate were excluded, and all the remaining 56 students were allocated to the intervention (n=29) and control (n=27) groups using the block randomization method. 9 students that did not participate in the second evaluation were excluded, and the study was finalized with 20 and 27 students in the intervention and control groups, respectively (Figure 1).

### Data Collection Tool

We developed a form to record age, gender, smoking habits, daily exercise, body mass index, arm circumference, compression rate, and depth during CPR, and satisfaction with the CPR training. The intensity of arm pain during CPR was measured using a 10 cm visual analog scale.

### Intervention

Nursing students who agreed to participate received two hours of theoretical lectures on basic life support for healthcare professionals. The training was based on the 2015 AHA guidelines for CPR and Emergency Cardiovascular Care (ECC) and was provided by an emergency medical expert with an AHA First Aid Trainer certificate. Following the theoretical lecture, participants were allocated to the intervention and control groups and performed at least 5 cycles of CPR (1 cycle=2 minute) on a high-fidelity simulation mannequin at the practice laboratory. During the performance, one student delivered rescue breaths

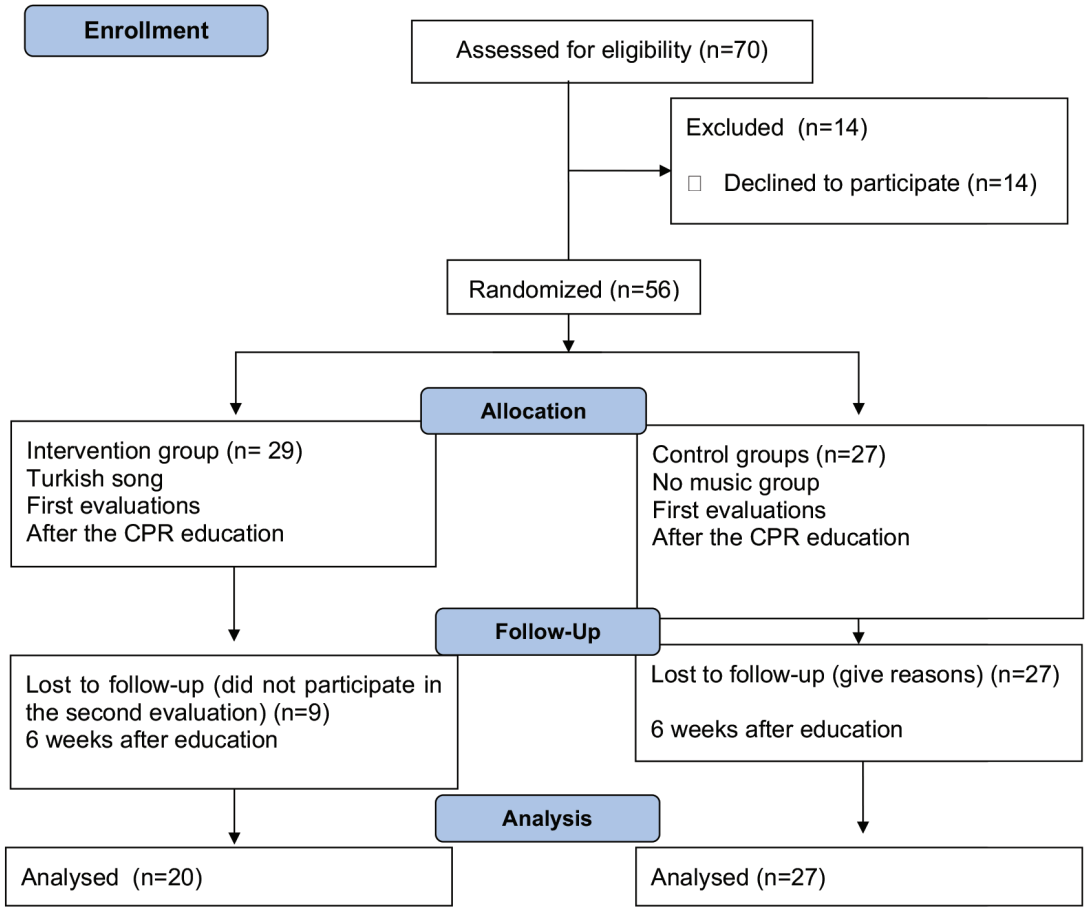


**Figure 1.**
**The Flow Diagrams of the Participants Through Each Stage of the Study**

using a bag valve mask, while the other student performed compressions. Participants switched positions after each cycle with 120 compression.

After the training, the students in the control group received standard CPR training, whereas the students in the intervention group listened to the song to be used in CPR and then performed CPR while listening to the song. A funky D mix version of a popular Turkish song by group Duman entitled "Senden Daha Güzel", which had 104 beats/min, was used during the CPR training of the intervention group. The CPR performance of the participants was evaluated just after the CPR training (short-term) and six weeks after the training (long-term).

### Measures

Following training, students were taken to the practice laboratory in groups of two and were asked to perform five cycles of CPR for two minutes with 30 chest compression and 2 breaths in each cycle. Participants performed CPR using a high-fidelity simulation mannequin entitled Advanced Wireless CPR Training Manikin (General Doctor® Model: GD/CPR10350, Honglian Medical, Shanghai, China).

### Outcomes

In line with the recommendations of the 2015 AHA guidelines for CPR and ECC, the primary outcome was expected to be a compression rate of 100-120/min and a depth of 5-6 cm. Data on the compression rate and depth, as well as the percentages of the compression-breath rate and correct compression rate, were provided by the mannequin. The secondary outcomes of this study were arm pain intensity during CPR and satisfaction with the CPR training.

### Ethical Issues

We obtained permission from the Scientific Research and Publication Ethics Committee of Eastern Mediterranean University (no: 2018-55-08, date: 12.03.2018). The nursing students were informed about the aim and scope of the research, and written informed consent was obtained. We informed the students that their decision not to participate in the research would not affect their education.

### Statistical Analysis

The data collected were analyzed using the Statistical Package for the Social Sciences (SPSS version 15.0). We used mean and standard deviation for the analysis of descriptive data that met normal distribution and median

and interquartile range for descriptive data that did not meet normal distribution. Mann-Whitney U and t-test were used for intergroup comparison. Chi-square test and Fisher's exact test were used to compare categorical variables. The Wilcoxon test was used to compare pre-training and post-education data. Statistical significance was set at $p<0.05$.

## Results

Characteristics of the nursing students The research was conducted with the participation of 20 and 27 nursing students in the intervention and control groups, respectively. There were no statistically significant differences between the two groups in terms of age, weight, height, and left and right arm circumference. In addition, the differences between the groups in terms of gender, smoking habits, educational status, daily exercise, and prior witness to basic life support were not statistically significant (Table 1).

### Intergroup Comparison

The difference between the intervention and control groups regarding the total and correct compression rates during one cycle (2 min) was not statistically significant ($p>0.05$). The false compression rate was higher in the intervention group than in the control group. There were no statistically significant differences in reasons such as depth of compression ($p>0.05$). The intervention and control groups did not significantly differ in parameters such as total and correct number of rescue breaths and compression-breath ratio were no statistically significant (Table 2). After the second measurement, there were no significant differences between the groups regarding the parameters of compression and breath were no statistically significant ($p>0.05$) (Table 2).

### Intragroup Comparison

Comparison of the first and second measures for the control group showed that incorrect compression and breath rates six weeks after the initial measurement were higher, whereas the correct compression rate was lower. There was no statistically significant difference regarding other parameters ($p>0.05$) (Table 2). Regarding the compression-breath rate, there was no statistically significant difference between the initial and second measures in the intervention and control groups ($p>0.05$). Regarding arm pain intensity after CPR, there was no difference between the two

***Table 1.***
***Descriptive Characteristics of the Nursing Students***

| | **Intervention (n=20)** | **Control (n=27)** | **p** |
|---|---|---|---|
| Age* | 22 (21-22.8) | 21 (21-22) | 0.506 |
| Weight* | 55.7 (47.5-68) | 57.2 (53-68.4) | 0.323 |
| Height¶ | 163.4±10.2 (160.6-170.1) | 162.4±9.4 (158.8-166) | 0.604 |
| Right arm circumference¶ | 25.3±3.5 (23.7-26.9) | 26.6±3.2 (25.4-27.8) | 0.195 |
| Left arm circumference¶ | 25.3±3.4 (23.7-26.9) | 26.0±3.1 (24.8-27.2) | 0.448 |
| Gender - n (%) | | | |
| Female | 15 (75.0) | 22 (75.9) | 1.0 |
| Male | 5 (25.0) | 7 (24.1) | |
| Education - n (%) | | | |
| High school | 13 (65.0) | 14 (48.3) | 0.441 |
| Anatolian/science high school | 6 (30.0) | 14 (48.3) | |
| Other | 1 (5.0) | 1 (3.4) | |
| Prior witness to BLT- n (%) | | | |
| Yes | 2 (10.0) | 6 (20.7) | 0.455 |
| No | 18 (90.0) | 23 (79.3) | |
| Daily exercise - n (%) | | | |
| Yes | 5 (25.0) | 11 (37.9) | 0.375 |
| No | 15 (75.0) | 18 (62.1) | |
| Smoking - n (%) | | | |
| Yes | 5 (25.0) | 7 (24.1) | 1.0 |
| No | 15 (75.0) | 22 (75.9) | |

**=Median (interquartile range), ¶=Mean ± Standard deviation (95% confidence interval)*

***Table 2.***
***Comparison of Intervention and Control Group Students' Data after CPR Training and Six Weeks Later***

| Variables | | Intervention (n=20) | Control (n=27) | p |
|---|---|---|---|---|
| | | Median (IQR) | Median (IQR) | |
| **Total compression/2 min** | **The first evaluation** | 177.0 (168.2-183.8) | 168.0 (133.0-181.0) | 0.113 |
| | **Six weeks later** | 180.5 (159.5-200.4) | 180.0 (153.0-188.8) | 0.421 |
| | **p** | 0.263 | 0.304 | |
| **Correct compression/2 min** | **The first evaluation** | 139.5 (109.8-150) | 140 (105.5-150) | 0.745 |
| | **Six weeks later** | 128.5 (119.3-150) | 123 (94-150) | 0.523 |
| | **p** | 0.868 | 0.201 | |
| **Wrong compression/2 min** | **The first evaluation** | 38.5 (29.3-59.3) | 28 (15.5-43.5) | **0.033** |
| | **Six weeks later** | 55 (30.3-60) | 45 (33-63.5) | 0.919 |
| | **p** | 0.654 | **0.000** | |
| **Percentage of correct compression -% (correct compression/total compression*100)** | **The first evaluation** | 78.9 (62.5-82.2) | 83.3 (71.4-90.6) | 0.097 |
| | **Six weeks later** | 71.8 (66.0-82.2) | 72.7 (61.4-82.0) | 0.935 |
| | **p** | 0.455 | **0.001** | |
| **Depth of chest compression >6 cm** | **The first evaluation** | 9.5 (3.3 -13.8) | 3 (2-10) | 0.073 |
| | **Six weeks later** | 8 (3.3-13.5) | 7 (2.5-14.5) | 0.799 |
| | **p** | 0.663 | 0.140 | |
| **Depth of chest compression <5 cm** | **The first evaluation** | 17.5 (7.3-24.3) | 10 (6-23) | 0.489 |
| | **Six weeks later** | 21.5 (5.8-37.5) | 19 (8.5-26) | 0.548 |
| | **p** | 0.112 | 0.066 | |
| **Total breath 2 min** | **The first evaluation** | 10 (7.3-11) | 10 (8.5-10.5) | 0.685 |
| | **Six weeks later** | 10 (8.3-11) | 10 (8-13) | 0.766 |
| | **p** | 0.656 | 0.787 | |
| **Compression/breath rate** | **The first evaluation** | 18.4 (15.1-21.8) | 16.6 (13.2-21.3) | 0.189 |
| | **Six weeks later** | 19.4 (14.1-21.4) | 15.9 (13.7-20.9) | 0.387 |
| | **p** | 0.370 | 0.510 | |

*IQR=Interquartile range, CPR=cardiopulmonary resuscitation*

groups measured in the short and the long terms (p>0.05). Satisfaction with the CPR training was significantly higher among the control group (p<0.05). In the intergroup comparison, the differences between the first and second evaluations for the groups were not statistically significant (p>0.05) (Table 3).

## Discussion

Studies on the impact of music on chest compression included approximately 40 popular songs (22). Although studies on the relationship between national songs and CPR performance are limited (20,23), we did not find any studies that used a popular Turkish song to evaluate the impact of musical memory on CPR performance. Despite the fact that music is universal, there is a relationship between music and the language spoken (24). A study that compared the effectiveness of metronome and popular national songs in CPR training found that CPR training using a popular song was more effective than metronome-guided training in helping laypersons to maintain recommended compression rates after 6 months (23). The study of Ho et al. (20) on the impact of culture-specific popular music to achieve the recommended compression rates of 100-120/min found that most of the participants could not achieve the recommended rates. The authors recommend using national songs to achieve an optimal compression rate during the training of lay persons. This brief review of the literature shows that the limited number of studies on the impact of national songs on CPR training mostly focused on compression rate. Thus, further studies on other dimensions of CPR training are required. This randomized trial to fill the gap in the literature found no statistically significant difference between the intervention and control groups regarding the compression and breath rates measured just after and six weeks after the CPR training. Besides, contrary

***Table 3.***
***Comparison of Arm pain Intensity and Satisfaction with the CPR Education***

| | | Intervention (n=20) | Control (n=27) | p |
|---|---|---|---|---|
| | | **Median (IQR)** | **Median (IQR)** | |
| **Arm pain** | **The first evaluation** | 1.5 (0.3-3.8) | 2 (0-4) | 0.701 |
| | **Six weeks later** | 2 (0.3-4) | 1 (0-3) | 0.236 |
| | **p** | 0.643 | 0.167 | |
| **Satisfaction** | **The first evaluation** | 9 (8-10) | 10 (10-10) | **<0.001** |
| | **Six weeks later** | 9 (8-10) | 10 (10-10) | **<0.001** |
| | **p** | 0.785 | 0.739 | |

*IQR=Interquartile range, CPR=cardiopulmonary resuscitation*

to our expectations, we found that training via a popular Turkish song had a negative impact on satisfaction with the CPR training.

Studies that evaluated the impact of music on CPR training and performance showed that chest compression rates were >100/min (6,15,17,25-27). In this study, there was no statistically significant difference between the first and second compression rates of the control and intervention groups. Although the AHA recommended a compression rate of 100-120/min, the mean compression rates of the intervention groups were 177 and 168 for the initial cycle of two minutes and 180.5 and 180 for the second evaluation (Table 2). These findings are far below the recommended values. Compression rate below 100/min is a frequent problem in actual CPR performance (28). Using songs to create a mental metronome is suggested to overcome this problem (17,26). Contrary to expectations, using a popular national song in our study did not help the participants in the intervention group meet the recommended compression rate. The visual perception of the participants in correcting this problem was also inadequate. Therefore, real-time visual feedback computer tools can be used to increase the rate and the efficiency of compression (14,29). A recent randomized controlled trial reported that these tools increased the survival rate of patients (30).

We found no statistically significant difference between the initial and second evaluation of total and correct compression rates in either group. Advanced Cardiac Life Support guidelines recommend 10 breaths for two minutes with 30 compressions and 2 rescue breaths in each of five cycles (31). In our study, participants in the control and intervention groups performed the optimal compression rates just after and six weeks after the training, so there was no statistically significant difference between the two groups. In addition, most participants provided sufficient breath. This relatively high rate of success in providing sufficient breath may be explained by the fact that the practice requires less effort. Nevertheless, our findings indicate the ease of learning artificial respiration.

Although the satisfaction of the participants in the control and intervention groups was relatively high, participants in the control group, who received standard CPR training, had statistically significantly higher satisfaction (Table 3). Given the fact that the participants found it easier to learn artificial respiration, compulsory learning of a song may have an impact on their satisfaction with the training.

### Study Limitations

This study has several limitations. First, this study was conducted at a single center; thus, the findings of the study may not be generalizable. Second, the high-fidelity simulation mannequins used in the study prevented the participants from switching unless they correctly performed the CPR with 30 compressions and 2 breaths in each cycle, which, in turn, may have influenced the findings on compression rates and the rate of the wrong compression. Finally, participants in the intervention group performed CPR on low-fidelity simulation mannequins, whereas participants in the control group performed CPR on high-fidelity simulation mannequins before data collection. Given that the two groups used high-fidelity simulation mannequins during the research practice, we may doubt that the students in the control group became used to performing practices using a high-fidelity simulation mannequin. Further studies on the impact of national music may use the same simulation mannequin during the training and evaluation periods.

### Conclusion

In conclusion, although existing studies have suggested that the use of popular music is an effective tool to achieve the recommended compression rate, this study did not find any significant impact of popular national music on chest compression performance.

### Ethics

**Ethics Committee Approval:** The study obtained permission from the Scientific Research and Publication Ethics Committee of Eastern Mediterranean University (no: 2018-55-08, date: 12.03.2018).

**Informed Consent:** The nursing students were informed about the aim and scope of the research, and written informed consent was obtained.

### Footnotes

**Authorship Contributions:** Surgical and Medical Practices – G.S.D., S.T., B.B., N.Ç.; Concept – G.S.D., S.T., B.B., N.Ç.; Design – G.S.D., S.T., B.B., N.Ç.; Data Collection and/or Processing – G.S.D., S.T.; Analysis and/or Interpretation –B.B., N.Ç.; Literature Review – G.S.D., S.T., B.B., N.Ç.; Writing – G.S.D., S.T., B.B., N.Ç.

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