

# JAMES MADISON

UNDERGRADUATE RESEARCH JOURNAL



Volume Eight 2020-2021



*We believe that great teaching and great research go hand in hand, and that students learn in transformative ways from participating in research that is original, creative, and collaborative. Research helps students learn how to ask new questions, and how to identify and solve complex problems.*

-Jonathan Alger,  
President of James Madison University

A photograph of a curved stone wall with the name 'JAMES MADISON UNIVERSITY' in large, dark, 3D block letters. The wall is set against a clear blue sky. In the foreground, there is a garden of yellow and purple tulips. The overall scene is bright and sunny.

**JAMES MADISON  
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# Letter from the Editors

Dear Reader,

Welcome to Volume Eight of the *James Madison Undergraduate Research Journal*! Amid the challenges, difficulties, and even heartbreak of the last year, this volume is a testament to the resilience of our JMU undergraduate researchers and scholars, our faculty reviewers, and our *JMURJ* Editorial Board members.

Volume Eight includes seven pieces from six majors in four JMU colleges: CISE, CAL, CVPA, and CHBS. In addition to excellent work by students in Psychology, History, and Health Sciences—majors previously represented in *JMURJ*—we have been delighted to publish submissions from Music, Computer Science, and Intelligence Analysis. Congratulations to our authors and to the professors and advisors who fostered their research and scholarship.

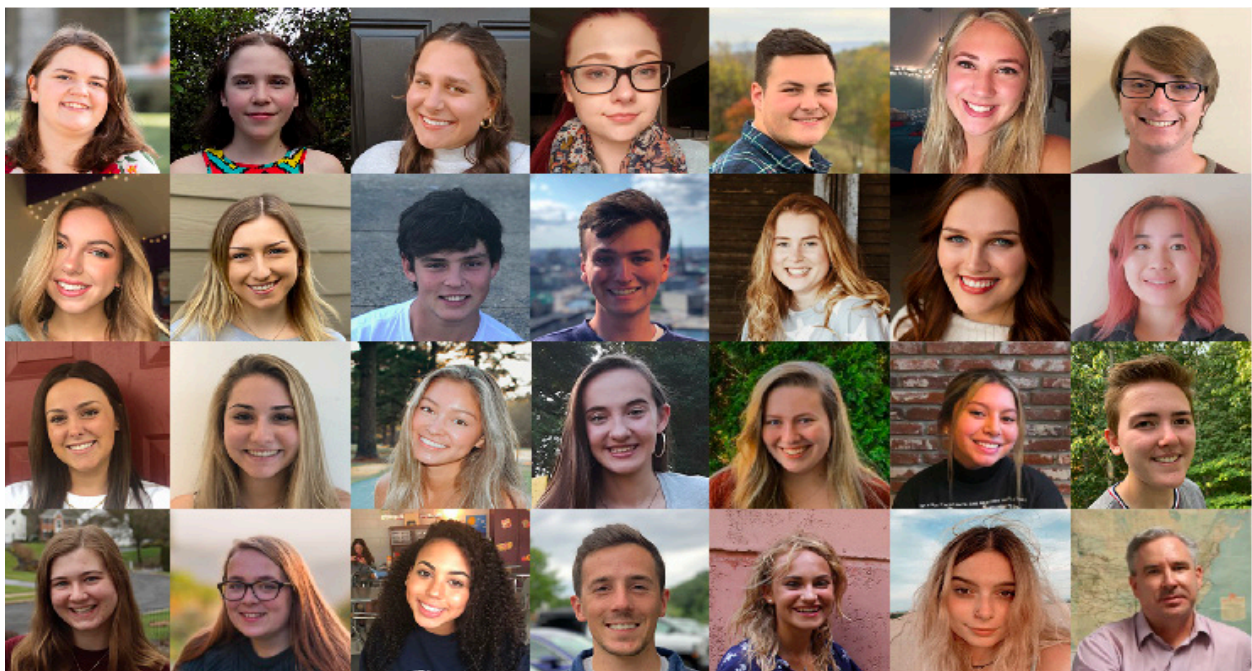
Thank you also to our faculty reviewers who volunteered their time and expertise in supporting *JMURJ*. Through eight *JMURJ* volumes, we've enlisted 233 different JMU faculty reviewers, including 19 Volume Eight first-timers. Your continuing support helps make publication a real, immediate possibility for undergraduate researchers and scholars in all of JMU's different disciplines, genres, and media.

Thank you, finally, to the 19 undergraduate students who served on the *JMURJ* Editorial Board during the 2020-2021 academic year. Our board met in person just once, back in August 2020, and the Spring 2021 board was an entirely online affair. Volume Eight of our journal is thus a product of our Zoom meetings and breakout rooms, long emails and GroupMe's, and your individual initiative. Congratulations to all of you, including our 14 graduating seniors.

Here in Fall 2021, a new *JMURJ* Editorial Board has worked to put the finishing touches on Volume Eight. As we've done so, in person for the first time in over a year, we've appreciated again all that our contributors, reviewers, and editors accomplished over the past year, as well as the foundation they built on.

All the best,

The *JMURJ* Editorial Board



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# Acknowledgments

We thank the 230+ faculty reviewers who have volunteered their time through the first eight volumes of *JMURJ*, starting with the 38 faculty reviewers who reviewed for Volume 8. Michael Smith, Director of the School of Writing, Rhetoric and Technical Communication, remains an enduring champion for *JMURJ*. We also want to acknowledge Vice Provost Anthony Tongen and Associate Vice Provost Keith Holland, Ms. Becky Rohlf, and Mr. Ben Delp in JMU Research and Scholarship for their assistance. We thank JMU Creative Media for their contributions to our publication. We have also enjoyed ongoing technical support from WRTC's Sandra Purington and Kristin Knapp and the Learning Centers' Joan Fahrney. Finally, we would again like to thank President Jonathan Alger and Provost Heather Coltman for their interest and encouragement as we work to promote, publish, and share undergraduate research and scholarship throughout the JMU community.



# Assessing Perceptions of Group Work Using Team-Based Learning

Lauren Ferry, Phillip J. Wong, and Kathryn Hogan

## Abstract

Group work is frequently incorporated into courses; however, student perceptions of their experiences and the benefits of group work might differ based on the structure of course. In this study, we examined student perceptions of group work in a team-based learning (TBL) course. Undergraduate students completed pre- and post-surveys on their team work experiences over a semester. Students had lower agreement with the statement “working in groups usually ends up with one person doing all of the work” and higher agreement with “working in a group makes me feel as though I am part of a learning community” at post-test. On an open-ended question comparing their group work experiences in the TBL setting to previous group work experiences, students had positive reactions, indicating that their teammates were prepared, accountable, and worked well together. While our small sample size leaves room to examine individuals’ different experiences with group work more closely, as a whole, TBL appears to provide a structure for group work that ensures individual accountability prior to team work and to provide a space for students to practice transferable skills valued by employers.

*Keywords:* group work, team work, team-based learning, student perceptions

Group work often plays a prominent role in higher education, and for good reason. Group work can foster communication skills, enable new and diverse perspectives, provide social support, and facilitate learning (Beebe & Masterson, 2003; Davis & Murrell, 1993; Felder & Brent, 2001; MacGregor et al., 2000). Beyond advantages of group work that can be seen in the classroom, participating in group work can develop skills that make students marketable when searching for jobs after graduation (Beebe & Masterson, 2003; Chapman & Van Auken, 2001). In fact, employers and job seekers alike emphasize the importance of communication skills, teamwork skills, and responsibility management (Hart Research Associates, 2018; Landrum & Harrold, 2003; Robles, 2012; Velasco, 2012).

### Student Perceptions of Group Work

Students generally have positive attitudes toward group work (Burdett, 2003; Chapman & Van Auken, 2001; Hassanien, 2007; Payne et al., 2006; Walker, 2001). For example, students believe that group work fosters a positive attitude toward learning, develops their communication and interpersonal skills, improves the learning process as group members engage each other in productive discussions, and allows them to meet new people and build friendships (Betta, 2016; Burdett, 2003; Chang & Brickman, 2018; Chapman & Van Auken 2001; Feingold, 2008; Frame et al., 2015; Johnson & Johnson, 2009). Students also appreciate diverse groups (Frame et al., 2015; Hassanien, 2007).

Students also recognize that there may be drawbacks, such as the perceived unfairness of a common grade for each group member regardless of the amount of effort put forth by each person (Payne et al., 2006). Additionally, it may be difficult to organize a time and place for everyone to meet, and lack of support or guidance from the instructor may make for less than ideal group work experiences for students (Burdett, 2003; Hassanien, 2007; Payne et al., 2006).

One of the more prominent problems when it comes to group work is social loafing (Burdett, 2003; Burdett & Hastie, 2009; Freeman & Greenacre, 2011; Hassanien, 2007). Social loafing is the practice of individuals exerting less effort on a task in a large group, compared to when working independently (Latané et al., 1979). Social loafing can result in some team members taking on more responsibility in completing a task and other members of the group also participating in social loafing (Jassawalla et al., 2009). Students also report that the loafer's behavior is distracting and disruptive during group activities (Jassawalla et al., 2009). Group work literature is filled with techniques to reduce social loafing, includ-

ing holding group members accountable through self, peer, or instructor evaluations, creating small groups, requiring group-devised contracts with clear expectations, and increasing individual member identifiability and accountability (Aggarwal & O'Brien, 2008; Bailey et al., 2005; Brooks & Ammons, 2003; Harkins & Szymanski, 1989; Karau & Hart, 1998; Szymanski & Harkins, 1987; Williams et al., 1981). Team-based learning incorporates many of these techniques.

### Team-Based Learning

Team-based learning (TBL) is a teaching method in which students learn the primary course content outside of class and work in permanent teams during class to apply course content (Michaelsen et al., 2004). TBL's deliberate structure may alleviate concerns that students generally have with group work, particularly given that students have positive attitudes when group work is structured and well-defined (Abdelkhalik et al., 2010; Butt, 2018; Vasan et al., 2009; Willis et al., 2002). Many of TBL's components—outlined below—align with recommendations for creating positive group work experiences (Oakley et al., 2004; Shimazoe & Aldrich, 2010).

#### Team Assignments

First, the instructor assigns students to permanent teams of five to seven students for the semester. Instructor-assigned groups are preferred to student-chosen groups because instructor-assigned groups are more likely to include students with various academic abilities and experiences and students from underrepresented groups, while they are less likely to include members who have pre-existing friendships (Deibel, 2005; Hodges, 2018; Oakley et al., 2004; Shimazoe & Aldrich, 2010; although see Chapman et al., 2006). There is debate about whether teams should be permanent (e.g., Delucchi, 2006; Michaelsen et al., 2014) or should change (Tanner et al., 2003; Johnson & Johnson, 2009) throughout the course of the semester. TBL promotes permanent teams because, although it takes some time, students who are in permanent teams become familiar with each other, become more effective communicators, are able to reach decisions more efficiently, promote shared experiences and knowledge among group members, and are more flexible as they work together (Huckman & Staats, 2013; Watson et al., 1991). Indeed, TBL promotes the transition from a collection of individuals working as a group to a cohesive team.

#### Quizzes

Second, students are held accountable for being prepared when coming to class through the use of individual and team quizzes. Generally, the structure of

TBL encourages students to be self-motivated, as their grades on the individual quizzes are dependent on their preparedness at the beginning of each class (Inuwa, 2012; Reinig et al., 2011). Because the class structure incorporates a Readiness Assurance Process to ensure individual students' accountability, pressure is removed from team members to hold each other accountable (Feingold, 2008; Frame et al., 2015; Willis et al., 2002). The team quizzes—which are identical to the individual quizzes—require students within a team to come to a consensus on their answers prior to recording them. They record their answers on an Immediate Feedback Assessment Technique (IF-AT) sheet, which enables them to scratch off their answer choice and receive immediate feedback as to whether they picked the correct or incorrect choice.

The team quizzes provide an understanding of which concepts are clear and which may need corrective feedback from the instructor. Team quizzes also hold individuals accountable to their teams. The format and length of these quizzes can vary depending on the content of the course. For example, in statistics courses, short (three to five questions) quizzes may be presented at the beginning of each class period to ensure students grasp all of the material. In other courses, quizzes may be presented at the beginning of each unit, with only five to seven quizzes in the entire semester (Michaelsen et al., 2004). Students complete individual and team quizzes at the beginning of class meetings. Following the quizzes, students receive “muddiest points” lectures, which clarify any information that is still unclear (or muddy). The individual and team quizzes, along with the muddiest points lectures, are essential to ensure students are prepared to complete the next component of TBL: application exercises.

### **Application**

Students complete application exercises that require them to come to a consensus on problems requiring an application of course concepts. The activities must be challenging enough to require all members of the team to contribute. Further, to contribute to the application exercises, students must have prepared individually, which is inherent in the structure of TBL. Students must communicate effectively within their teams and with other teams in the class to be able to make their arguments for the specific decisions they make. The structure of TBL naturally allows for students' perceived benefits of group work, such as improving communication skills and having engaging discussions. The process of individual quizzes, muddiest points lectures, and application exercises can be repeated in each class period, structured to be completed in one week, or

spread across multiple weeks in the semester, depending on the course content and structure.

### **Peer Evaluations**

Finally, peer evaluations contribute to students' final grades. Peer evaluations provide another point of accountability of students to their teammates (Stein et al., 2016). Similar to their perceptions of group work, students have both positive and negative perceptions of peer evaluations. Students believe peer evaluations improve their learning, possibly through consciously evaluating their own performance (Brindley & Scofield, 1998; Dochy et al., 1999) and appreciate that they can impact their peers' grades (Chen & Lou, 2004); however, they also recognize that peer evaluations may put a strain on relationships and result in competition among members of the group (Brindley & Scofield, 1998). Formative and summative evaluations promote positive student experiences of working in teams, including decreased social loafing (Chen & Lou, 2004; Harkins & Szymanski, 1989), particularly when the purpose of the evaluation is transparent (Chen & Lou, 2004). Having students rate their peers using quantitative and qualitative evaluations requires students to really reflect on their peers' contributions (Cestone et al., 2008) and can provide qualitative feedback to their peers to facilitate improvement.

### **Purpose**

In sum, past research on group work in education has suggested numerous benefits to team-based learning, including improved communication skills, exposure to diverse perspectives, and increased social support throughout the learning process (Beebe & Masterson, 2003; Davis & Murrell, 1993; Felder & Brent, 2001; MacGregor et al., 2000). Despite these advantages, group work also involves some drawbacks, namely social loafing (Jassawalla et al., 2009). Team-based learning may be a solution to improve students' experiences with group work by emphasizing student accountability and communication skills. In this study, we were interested in whether students' perceptions of group work would change after participating in a TBL class, given the structure that TBL provides. We expected that students would have more positive perceptions about group work after participating in a TBL course.

### **Method** **IRB**

A faculty mentor received IRB approval before collecting pre- and post-test data to compile a dataset. We used this dataset in our study, coding the relevant qualitative data and analyzing the relevant quantitative and qualitative data.



## Participants

Sixty-eight participants (54 female; 14 male) were enrolled in an upper level developmental psychology class at a medium-sized state university. Participants were primarily juniors and seniors, as well as a few sophomores ( $M_{age}=21.2$ ;  $SD_{age}=2.89$ ). Participants received course credit for completing the pre-test and post-test.

## Materials and Procedure

During the first week of the semester, participants answered 12 closed-ended questions and two open-ended questions regarding their perceptions of group work. On the first day of class, students were assigned to teams and remained in these teams for the duration of the semester. The class covered a chapter each week. Students prepared for chapters by completing readings using reading guides prior to coming to class.

Each Monday, students completed an individual quiz and then completed the same quiz with their teams. Students had 15 minutes to complete each 20-item multiple-choice quiz individually. The allotted time for team quizzes was determined by how quickly teams completed the quiz, which varied based on the difficulty of the content; once 80% of the teams completed the quiz, the rest of the teams had 5 minutes to complete it. After the team quizzes, students participated in a muddiest points lecture, which lasted 10 to 30 minutes, to clarify content from the readings and quizzes.

Each Wednesday, students worked in their teams for 25 to 40 minutes to complete application exercises that consisted of multiple questions. Each question was designed for each team to work the same problems and make a single decision, which they reported simultaneously to the class; this is consistent with the structure described in the TBL literature (Michaelsen et al., 2004). Specifically, assignments within TBL should involve a problem that is significant to the students, all students should work on the same problem, students must make a specific choice, and groups should report their choices simultaneously (Michaelsen et al., 2004). Next, students had a full-class discussion about the decisions each team made. Students completed a formative team evaluation during the semester and then a final team evaluation at the end of the semester, both of which contributed to their final grade.

During the last week of the semester, students completed the same questionnaire about their perceptions of group work that they worked through at the beginning of the semester, with an additional five items specific to group work in the current TBL class, including an open-ended question: “How does your group work in this class compare to your past experiences with group work?”

## Results

### Pre- and Post-Test Student Perceptions

We conducted a paired  $t$ -test to compare students' answers to the pre- and post-test survey items to evaluate if students' perceptions of group work changed before and after taking a TBL class. We used Bonferroni correction to account for running multiple tests at once and set the cutoff for significance at  $p<.004$  ( $\alpha=.05/12$ ); being more conservative with the  $p$  value reduced the chance of a Type 1 error. Students were less likely to agree with the statement that “working in groups usually ends up with one person doing all of the work” at post-test ( $M=2.17$ ,  $SD=.87$ ),  $t(65)=5.16$ ,  $p<.001$ ,  $d=.64$ , compared to pre-test ( $M=2.98$ ,  $SD=1.05$ ). Students were more likely to agree with the statement that “working in a group makes me feel as though I am part of a learning community” at post-test ( $M=4.35$ ,  $SD=.64$ ) compared to pre-test ( $M=4.02$ ,  $SD=.77$ ),  $t(65)= -3.6$ ,  $p=.001$ ,  $d=.44$ . No other differences between the pre- and post-test means were significant (see Table 1).

Table 1. Pre- and Post-Test Mean Responses on a 5-point Likert scale.

Question	Pre-test $M(SD)$	Post-test $M(SD)$	$p$
Working in groups usually results in one person doing all of the work.	2.98 (.105)	2.17 (.87)	<.001*
I am able to learn from my peers.	4.61 (.52)	4.76 (.47)	0.04
Working with groups can help me understand other points of view.	4.73 (.45)	4.74 (.47)	0.829
Working in a group makes me feel as though I am part of a learning community.	4.02 (.77)	4.35 (.64)	0.001*
Working in groups can help me develop new skills and knowledge from members in my group.	4.48 (.59)	4.41 (.70)	0.34
I learn better from lectures than from working in groups.	3.21 (.85)	2.98 (1.10)	0.129
Solving problems in a group is an effective way to learn.	4.41 (.66)	4.39 (.58)	0.877
I have a positive attitude about working with my peers.	4.18 (.91)	4.29 (.80)	0.3
The ability to collaborate with my peers is necessary if I am to be a successful student.	4.33 (.92)	4.35 (.81)	0.885
Solving problems in a group is not an effective way to practice what I have learned.	1.71 (.86)	1.76 (.88)	0.75
Generally speaking, I like working in groups.	3.53 (1.03)	3.74 (.90)	0.051
Group work prepares you for your future career.	4.55 (.66)	4.53 (.64)	0.871

Note. In the Likert Scale, 1=strongly disagree and 5=strongly agree. \*Paired  $t$ -test significant at  $p<.004$ .  $N=68$ .

## Open-Ended Question Response

We focused on how students answered a single open-ended question in the dataset: “How does your group work in this class compare to your past experiences with group work?” The sample of 68 students provided 116 codable responses (see Table 2). In other words, many students provided more than one codable response. We evaluated student responses on two dimensions. First, we coded students’ overall responses in terms of whether they believed their group experiences in the TBL class were positive, negative, the same or similar, or neutral compared to their previous group work experiences. Overwhelmingly (110 out of 116 responses), students’ responses indicated that they perceived their group work in TBL to be a positive experience compared to their previous group work experiences. No students reported a negative experience with group work in the TBL course compared to previous group work, one student reported a neutral experience, and five students reported an experience that was the same as or similar to previous group work experiences.

Table 2. Percentage of Participant Responses Within Each Theme by Response Type

Response Type	Account.	Collab.	Group Quality	Other Themes	No Theme	Total
Positive	36 (33%)	22 (20%)	20 (18%)	13 (12%)	19 (17%)	110
Negative	0	0	0	0	0	0
Same-Similar	1	0	0	0	4	5
Neutral	0	0	0	1	0	1
Total	37	22	20	14	23	116

Note. Response Types were based on how the present group work experience compared to past group work experiences.

Second, we coded for specific themes that students reported. We identified three main themes based on students’ responses. One theme that emerged was accountability, which involved responses that indicated that teammates came to class prepared, that teammates’ preparation helped the success of the team, and that teammates contributed to the work equally (i.e., no one teammate did all of the work). Examples of responses coded under this theme include “This is the first time I’ve felt like group members have actually shared the workload” and “My group did a great job of being prepared.” Another theme was collaboration, which focused less on evaluating students’ individual preparation and effort than on their work with the actual team as a whole. Collaboration involved responses that indicated that the team worked well together, that they were cooperative, and that teammates participated. Examples of student

responses include “I feel like everyone contributed” and “My group worked really well together and shared the work evenly.” The theme of quality of group included responses that described the characteristics of team members or the team as a whole. For example, the motivation of teammates was included in this theme, such as “We had respect for each other and wanted to do the best for the group” or “[We were] all motivated to do well.”

We originally coded for other themes, including responses related to communication among teammates (“[TBL] was more interactive and discussion driven”), the long-term duration of the team (one student stating “Nothing long term like this”), and learning and education (“I felt like I learned a lot from the practical exercise”), but we had relatively few responses in these themes. These themes are grouped as other themes in Table 2. Finally, we established a no theme category for responses that did not fit with the other themes or address the open-ended question. The category covered a wide array of responses, from one-word answers such as “Better” or “Great” to responses such as “My group actually does work” and “Best group ever!” Thirty-seven responses (32%) were coded as the accountability theme, 22 (19%) of responses were coded as the collaboration theme, 20 (17%) were coded as the quality of group theme, 14 (12%) were coded as other themes, and 23 (20%) were coded as no theme when rounding percentages.

## Discussion

Generally speaking, students indicated that they liked working in groups and had positive experiences with working in their groups. Students began the TBL class already having positive perceptions of group work in the classroom, and many of these positive attitudes toward group work did not change over the course of the semester. For example, students felt that working in groups helps them learn about others’ perspectives and develop new skills and knowledge, and that working in groups to solve problems is an effective way to learn. Students felt that collaborating with others is necessary for them to be successful as students and that group work prepares them for their future careers.

Students changed their views on two aspects of group work. At the end of the semester, students agreed less that group work results in one person doing all of the work, and students agreed more that working in a group makes them feel like part of a learning community. When students feel valued as a member of a learning community, they become more self-motivated learners (Davis & Murrell, 1993). Notably, the themes that emerged from the open-ended question about how students’ group work experiences in this class compared

to their group work experiences in other classes largely mapped on to where we saw the changes in their quantitative answers. Over half of the qualitative responses we coded were related to the accountability and collaboration themes.

The positive shifts evident in both the quantitative and qualitative data may be a function of the structure and components of TBL. Working in permanent teams for the duration of the semester may increase feelings of connectedness and as members of a learning community, which previous studies show decrease social loafing (Jassawalla et al., 2009; Springer et al., 1999). Having permanent teams may facilitate students getting to know each other and how to communicate effectively (Huckman & Staats, 2013), which is difficult to do if teams change throughout the semester. Additionally, the decreased perceptions of social loafing may be a result of the built-in accountability for team members to come to class prepared prior to participating in team work. Individual preparation also likely contributes to positive team experiences during the application exercises because everyone should be on the same page in terms of content knowledge by the time students work on the application exercises. Individual accountability coupled with accountability through team evaluations may have also decreased perceptions of social loafing, and is consistent with previous literature that evaluations are effective (e.g., Karau & Hart, 1998).

Although the literature is mixed in terms of the effectiveness of TBL for content mastery (e.g., Carmichael, 2009; Jakobsen & Daniel, 2019; Jakobsen et al., 2014; Travis et al., 2016; Zingone et al., 2010), TBL's structure may provide value above and beyond this goal. For example, it provides opportunities for students to practice valuable transferable skills that are necessary in the workforce and allows students the chance to build a better understanding of themselves and others. In a 2018 survey of employers on student learning objectives, a majority of employers indicated that individual accountability, teamwork, communication, and problem-solving skills are all very important (Hart Research Associates, 2018). The TBL structure places emphasis on building these skills.

### Limitations and Future Directions

Students had good perceptions of working in teams coming into the semester, so there was not much room for them to improve their perception. Many students in the psychology major have access to other classes in which they have to prepare individually prior to working with others during class, which may have provided students with positive experiences before coming to

this class. Students with less experience with group work (or with less positive group experiences) may come into a TBL class with less positive perceptions of group work and may therefore show positive changes in perception of group work after participating in a group work structure within the TBL context. However, we did see that students' perceptions improved on two important dimensions—social loafing and being members of a learning community—which is promising evidence that the structure of TBL can help mitigate concerns of working in teams.

Another limitation of our data is that it is quasi-experimental. While we were able to show changes in student perception within a TBL class from pre-test to post-test, further research is needed to demonstrate that the positive changes in group work were due to TBL specifically and not group work in general or other variables. A replication of this study with the addition of a control group would strengthen the design and provide further evidence. Future research should also explore other factors that may impact students' perceptions of group work. Individuals with diverse cultural backgrounds, personality traits, and genders may have very different experiences working in groups (Myers et al., 2009; Šerić & Praničević, 2018). For example, students who score higher on introversion may experience group work in a different way than students who score higher on extroversion (Persky et al., 2015), and their peer evaluation scores may be negative because face-to-face interactions may be challenging for them (Voorn & Kommers, 2013). The existing literature on the relationship between introversion, extroversion, and group work in higher education is limited (e.g., Watson et al., 2010).

While restructuring an entire class to use TBL may be daunting, the principles of team work that provide positive experiences for students can be incorporated into almost any class. Ensuring individual accountability prior to team work, using permanent teams, and having students complete team work during class may be achieved in many courses, no matter their structure or content; even online environments can have synchronous meetings that facilitate teams working together at the same time. These learning settings can provide opportunities for further research that examines the intersections between individual students' quantitative and qualitative responses to TBL.

## Authors' Note



### Lauren Ferry

Lauren Ferry ('19) graduated summa cum laude with a degree in Psychology and a minor in Philosophy. She is currently in the Clinical Psychology doctoral program at Xavier University. She hopes to work as a therapist with children and adolescents. Lauren thanks Dr. Krisztina

Jakobsen for the opportunity to serve on her research team and for her knowledge and guidance during the research process. Additionally, Lauren thanks her parents, Craig and Gina Ferry, for supporting her throughout her endeavors.



### Phillip J. Wong

Phillip J. Wong ('19) graduated with a degree in Psychology and a minor in Sociology. He hopes to earn his master's degree in Library and Information Science in pursuit of a career as an archivist. His interests include cooking, reading, playing piano, and working in academic

and public libraries. He is currently a Library Assistant with the Virginia Beach Public Library system. Phillip is grateful to Dr. Krisztina Jakobsen for granting him the opportunity to be a part of her research team, and for the guidance provided by *JMURJ* throughout the publication process.



### Kathryn Hogan

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# When I Wore a Younger Man's Clothes

## The Nostalgia Topic in the Music of Billy Joel

Kendall Waters

### Abstract

My father and I often listened to Billy Joel together as I grew up, and I eventually formed nostalgic connections to Joel's music. While music is well known as a conductor of nostalgia, this paper explores the idea that the nostalgia I feel while listening to specific songs in Joel's catalog is not simply a result of the indexical connections I have built with these tracks. Rather, it is a result of a "nostalgia topic" in Joel's work. This paper compares the soundtrack and select works from Joel's catalog to reveal that there is no one gesture, melody, or harmonic progression that Joel relies on to create these connections. Instead, Joel amasses a collection of differing musical elements from his nostalgic soundtrack that he then places into the care of the piano. I therefore argue that Joel's use of the piano evokes the nostalgia topic in his work.



In my world, singer, pianist, and songwriter Billy Joel is a legend. I grew up listening to him with my dad, and we have even argued about which of Joel's songs we should use for the father-daughter dance at my wedding. I often feel nostalgic when listening to Joel, partly because I associate him with my dad; I notice commonalities in the specific Billy Joel songs that make me feel the most nostalgic. These include "Piano Man" from the 1973 album of the same name, "Miami 2017" from the 1976 album *Turnstiles*, "The Stranger" from the 1977 album of the same name, "Goodnight Saigon" from the 1982 album *The Nylon Curtain*, and "Leningrad" from the 1989 album *Storm Front*. I propose that the nostalgia I feel while listening to these works is not simply a result of the indexical connections I have built with these tracks, but that it is also the result of a "nostalgia topic" in Joel's work. I connect the music of Joel with the music of those he cites as musical influences, and I conclude that Joel evokes nostalgia in his music through subtle musical gestures that suggest melodies and progressions similar to those of artists with whom he, and possibly his audience, have built nostalgic connections. In many cases, Joel reveals these gestures through his piano music, suggesting that the use of the piano itself evokes the nostalgia topic in his work.

## The Semiotics of Nostalgia

Though my discussion concerns music, my meaning of the term "nostalgia topic" is answered by definitions that are most at home in the study of semiotics. Semiotics, or the study of signs, can be concisely described as the study of anything representing something other than itself. In semiotic terms, topics are symbols, or anything that represents an object by convention.<sup>1</sup> They are additionally a subset of gestures, defined as any intentional movement or action meant to convey information, whether understood by an observer or not.<sup>2</sup>

Specifically, topics appear when several gestures work together to convey a given meaning that is conventionally understood by an observer.<sup>3</sup> Popular examples of topics within musical works include the military topic, which is evoked through the occurrence of a march or fanfare section within a piece of music that is not identified as a march or fanfare, and the pastoral topic, which is evoked through the concurrent gestures of a narrow melody, a slow pace, and a drone, or a single pitch that is constant throughout the musical work.<sup>4</sup> Therefore, by

using the term "nostalgia topic," I refer to various musical gestures that conventionally represent nostalgia.

### *I notice commonalities in the specific Billy Joel songs that make me feel the most nostalgic.*

Nostalgia itself is a fluid term, and different scholars provide different explanations of what nostalgic experiences entail. Sociologist Janelle Wilson contends that nostalgia involves the intense change in emotional state that results from a nostalgist's choice of what to remember and how.<sup>5</sup> Anthropologist Marc Augé claims there are two different kinds of nostalgia: a longing for the past as remembered and a longing for what could have been, as produced by the nostalgist's imagination.<sup>6</sup> These two assertions require active participation from a nostalgist. Philosopher Scott Alexander Howard provides a counterargument implying a nostalgic experience could occur without so much participation; he writes that nostalgia is the spontaneous recovery of a remote event, usually triggered by a sensory cue and accompanied by a strong sense of joy.<sup>7</sup>

Given these differing understandings of nostalgia, we must use a loose definition of the term. Our working definition paraphrases Howard: whether they are actively sought after or passively experienced, "episodes of nostalgia are memory representations of an unrecoverable past, seen, at least in the moment, as meriting desire."<sup>8</sup> Another facet of nostalgia is that it can be collective or private, meaning it can pertain to a group or to the individual.<sup>9</sup> An example of a private nostalgic reminder could be a beloved parent's home-cooked specialty, while a collective nostalgic reminder might be a popular line dance song such as Rednex's "Cotton Eye Joe" or Village People's hit "Y.M.C.A." Though many of the musical gestures examined in this paper can be classified as private reminders for Joel, they are discussed with the purpose of finding out how their appearance in his music turns them into collective reminders for his listeners. In other words, this discussion focuses on Joel's personal nostalgic feelings, how he invokes them in his music, and how these invocations become a larger representation of nostalgia for Joel's listeners.

1 Jonathan Gibson and John Peterson, "Semiotics" (lecture, James Madison University, Harrisonburg, VA, January 16, 2020).

2 Jonathan Gibson and John Peterson, "Gestures" (lecture, James Madison University, Harrisonburg, VA, January 30, 2020).

3 John Peterson, "Topoi 001," James Madison University, April 8, 2020, video of lecture, [https://www.youtube.com/watch?v=ApZDO\\_xp5E4&feature=youtu.be](https://www.youtube.com/watch?v=ApZDO_xp5E4&feature=youtu.be).

4 John Peterson, "Topoi 002," James Madison University, April 7, 2020, video of lecture, <https://www.youtube.com/watch?v=Z1Q2iWbxA8M&feature=youtu.be>.

5 Janelle L. Wilson, "Remember When...: A Consideration of the Concept of Nostalgia," *ETC: A Review of General Semantics* 56, no. 3 (1999): 299, [www.jstor.org/stable/42705763](http://www.jstor.org/stable/42705763).

6 Marc Augé, "Nostalgia," in *Everyone Dies Young: Time Without Age*, trans. Jody Gladding (New York: Columbia University Press, 2016), 75-76, doi:10.7312/auge17588.12.

7 Scott Alexander Howard, "Nostalgia," *Analysis* 72, no. 4 (2012): 644, [www.jstor.org/stable/23359115](http://www.jstor.org/stable/23359115).

8 Howard, "Nostalgia," 647.

9 Wilson, "Remember When: A Consideration of the Concept of Nostalgia," 300.

## Joel's Private Nostalgia

The question of how the nostalgia topic comes across in Joel's work can be answered by exploring the psychological relationship between music and nostalgia. First, the degree to which a song is important in a person's life can have an impact on the level of nostalgia experienced by the listener when hearing the song. Barrett et al., researchers who have studied the intersections between music and psychology, find that higher levels of nostalgia are experienced when songs are "autobiographically salient" to a listener.<sup>10</sup> "Autobiographically salient" music refers to music that is important in someone's life: for example, the song that was playing when a romantically involved couple shared their first kiss may be autobiographically salient to both partners.

Two of the five case studies in this discussion feature lyrics that are highly autobiographical for Joel. "Piano Man" was written about the regulars at a piano bar at which Joel worked after the release of his first album.<sup>11</sup> "Leningrad" was written about a Russian man who met and later befriended Joel and his daughter during the Cold War.<sup>12</sup> Two of the remaining three cases, while not strictly autobiographical, still contain autobiographical elements, and Joel uses the non-autobiographical elements in these cases to create a character for himself, like an actor portraying a character in TV or film. "Goodnight Saigon" was written for friends of Joel's who had served in Vietnam; they reportedly "[told him] what to write."<sup>13</sup> Despite the fact that Joel himself did not serve, the experiences related in the song were still passed on from men who had, and the text carries that autobiographical weight. Finally, his song "Miami 2017" was intended as a science fiction song written from the point of view of Joel as a grandfather living in Miami, telling his grandkids about "when New York went down the tubes."<sup>14</sup> Though not strictly autobiographical, the song still carries autobiographical weight. At the time of its composition, New York was in a severe financial bind,<sup>15</sup> and the song was an "apocalyptic vision" of what would happen should the city default.<sup>16</sup> In Joel's case, au-

tobiographical details affect the text as well as the music; it makes sense that the nostalgia that comes with telling a personal anecdote influences the mood of the music.

Second, nostalgic connections to music tend to be made in the adolescent years. Journalist Katherine Gillespie used an analysis of Spotify listening data to investigate at which age people tend to solidify their favorite songs; most women make these connections during the age range of 11-14, and most men make these connections during the age range of 13-16.<sup>17</sup> Joel was born in 1949, so he would have been solidifying his nostalgic musical connections from about 1962 to 1966, give or take a year or two. In this way, the psychology behind nostalgic connections made to music provides some of the tools needed to figure out how the nostalgia topic reveals itself in Joel's work.

### *Joel's musical taste spans an interesting mix of artists from different genres.*

The other tools required to define the nostalgia topic in Joel's music are provided by Joel himself, who has spoken extensively on his many musical influences. As his music is an eclectic blend of styles and genres, it is not surprising that Joel's musical taste spans an interesting mix of artists from different genres. For example, Joel cites the jazz pianist Dave Brubeck and the soul artist Otis Redding as influences.<sup>18</sup> Both men were pioneers in their respective genres. Brubeck's unique use of strange time signatures and polytonality, or the simultaneous use of two or more tonal centers in a given work of music, proved appealing to the general public. And his 1959 record, *Time Out*, became the first jazz record to become a certified gold record.<sup>19</sup> Redding's music not only influenced musicians such as Aretha Franklin and Marvin Gaye, who would go on to shape the soul genre, but also quietly encouraged revolution in the era of the civil rights movement; Redding's 1966 "Try a Little Tenderness" joined a host of covers by black musicians "announcing the sound of soul while symbolically reversing the process by which white artists had appropriated and profited on black musical innovation."<sup>20</sup> Arguably, one of the biggest influences on Joel's music is the Beatles, who Joel admired as a young man and continues to cite as an

<sup>17</sup> Katherine Gillespie, "The Science Behind Music's Nostalgic Power," *Vice*, last modified April 2, 2018, accessed April 4, 2020, [https://www.vice.com/en\\_au/article/43bxpn/the-science-behind-musics-nostalgic-power](https://www.vice.com/en_au/article/43bxpn/the-science-behind-musics-nostalgic-power).

<sup>18</sup> Billy Joel, "Billy Joel Talks About His Musical Influences - SiriusXM 2016," produced by SiriusXM, March 21, 2016, Audio interview, [https://www.youtube.com/watch?v=DrocXvCyFlo&list=PLCcq\\_CUdaonuHjrnf5jXFlxExsgLqG9uY&index=3](https://www.youtube.com/watch?v=DrocXvCyFlo&list=PLCcq_CUdaonuHjrnf5jXFlxExsgLqG9uY&index=3).

<sup>19</sup> Hedrick Smith, "The Music of the Classic Quartet," *Rediscovering Dave Brubeck with Hedrick Smith*, PBS, accessed March 21, 2021, <https://www.pbs.org/brubeck/themusicclassicquartet.html>.

<sup>20</sup> Emily Lordi, "Hearing Otis Redding's 'Try a Little Tenderness' as a Song of Resistance," *The Atlantic*, accessed March 21, 2021, <https://www.theatlantic.com/entertainment/archive/2017/12/otis-reddings-try-a-little-tenderness-as-a-song-of-resistance/547655/>.

<sup>10</sup> Frederick S. Barrett et al., "Music-Evoked Nostalgia: Affect, Memory, and Personality," *Emotion* 10, no. 3 (June 2010): 390-403, doi:10.1037/a0019006.

<sup>11</sup> Billy Joel, "Billy Joel Talks About The Album 'Piano Man' - SiriusXM 2016," produced by SiriusXM, March 19, 2016, Audio interview, <https://www.youtube.com/watch?v=J9miGlmQ24I&feature=youtu.be>.

<sup>12</sup> Billy Joel, "Billy Joel Talks About The Album 'Storm Front' - SiriusXM 2016," produced by SiriusXM, July 19, 2016, Audio interview, <https://www.youtube.com/watch?v=anRfYE4yLO8&feature=youtu.be>.

<sup>13</sup> Billy Joel, "Billy Joel Talks About The Album 'The Nylon Curtain' - SiriusXM 2016," produced by SiriusXM, May 31, 2016, Audio interview, <https://www.youtube.com/watch?v=ociEzSFID8g&feature=youtu.be>.

<sup>14</sup> Billy Joel, "Billy Joel Talks About The Album 'Turnstiles' - SiriusXM 2016," produced by SiriusXM, April 11, 2016, Audio interview, <https://www.youtube.com/watch?v=Nlooy7zf-HY&feature=youtu.be>.

<sup>15</sup> Billy Joel, "Billy Joel - Q&A: What Was The Inspiration For 'Miami 2017'? (UPenn 2001)," An Evening of Questions & Answers, University of Pennsylvania, November 6, 2001, Q&A video, [https://www.youtube.com/watch?v=m\\_tXo9IVLTK](https://www.youtube.com/watch?v=m_tXo9IVLTK).

<sup>16</sup> Joel, "Billy Joel Talks ... 'Turnstiles.'"

influence today.<sup>21</sup> The fascinating commonality among many of the artists Joel mentions in interviews is that a majority of the tracks and albums discussed were released during the mid to late 1960s. The Beatles' albums *Rubber Soul*, *Revolver*, and *Sgt. Pepper's Lonely Hearts Club Band* were released in 1965, 1966, and 1967 respectively. It must be acknowledged that some of the music Joel discusses was first released outside the admittedly narrow time window of 1962-1966. However, because of Joel's in-depth explanations about this music's influence on his work and the meaning it has taken in his life, I feel confident including these works in my discussion as possible sources of nostalgia for Joel.

## Our Collective Nostalgia

Analyzing songs created by the artists Joel cites as influences for his nostalgic soundtrack exposes a shared set of musical gestures, progressions, and melodies. These commonalities reveal both the depth of Joel's own nostalgia and the sensory cues that evoke nostalgic desire for his audiences, including my father and me.

### Jazz and Dave Brubeck

Joel's calling card, "Piano Man," is heavily influenced by both jazz and classical idioms. "Piano Man" features an opening piano solo full of jazzy harmonies and extensions that morphs into a traditional waltz rhythm while a harmonica joins. The opening solo begins with an ascending arpeggio, or a sequence of separate pitches that form a chord when heard simultaneously. This arpeggio leads into a short descending chromatic scale and ends with more chromatic flourishes in the middle register before turning to the waltz rhythm that grounds the song; when I say chromatic, I mean that pitches in these passages are separated by a half-step, which is the shortest musical distance attainable on a standard keyboard. One key influence on "Piano Man" is Dave Brubeck and his 1959 album titled *Time Out*. Brubeck and *Time Out* are the main jazz influences that come up in interviews with Joel, and the second track of Brubeck's album, "Strange Meadow Lark," features elements that are very similar to elements in "Piano Man."<sup>22</sup> Like "Piano Man," "Strange Meadow Lark" features an opening piano solo that in turn opens with two main gestures: an upwards glissando in the high register of the keyboard and a downwards quasi sequence that leads into a short melodic interlude in the middle register.

Of course, there are some notable differences between these two songs; unlike the solo in "Piano Man," the main

gestures do not make up the entire "Strange Meadow Lark" solo, which is a two-minute affair. Instead, the two gestures are interspersed with other colorful melodic gestures, and the solo forms an arch in which these gestures act as the ends of the arch. The "Piano Man" solo, on the other hand, is very condensed, lasting about eight seconds, and the end of the solo does not bring any opening material back from the beginning. Despite these differences, both piano solos are built on a very small number of motivic ideas with the similar contour of a quick upwards gesture, a slow return downwards, and closing material in the middle register. It is these core similarities, as well as Joel's public acknowledgment of Brubeck's influence on him and his music, that connect "Piano Man" and "Strange Meadow Lark."

### Soul, R&B, and Otis Redding

The opening and closing piano solos of "The Stranger" also imply the jazz genre with their improvisatory style and the accompaniment of brushes on drums. However, it is not just Brubeck's influence that separates Joel's music from that of other rock musicians; Otis Redding's influence appears as well. Specifically, Joel discusses "Try a Little Tenderness," a track Redding first recorded in 1966. While Joel's discussion of this song focuses more on Redding's vocal techniques than on instrumental elements, the opening and closing piano solos of "The Stranger" gesture at "Try a Little Tenderness."<sup>23</sup> Both solos in "The Stranger" consist of sustained piano chords in the lower register and a decorated piano melody in the higher register, and the slight push and pull of the tempo as well as the sprinkling of ornamentation suggests improvisation. "Try a Little Tenderness" does not feature a piano solo at all, but the piano does fade in and out as Redding sings. The similarities between the piano solos in "The Stranger" and the piano part in "Try a Little Tenderness" do not lie in the contour of the melody or similar gestures, but instead in the harmonic progression and the playing style.

***The opening and closing piano solos of "The Stranger" also imply the jazz genre with their improvisatory style and the accompaniment of brushes on drums.***

In Spotify's recording of "Try a Little Tenderness," 0:20 marks the beginning of a quiet piano progression that sounds very much like the one in the solos in "The Stranger"; 0:44 marks the end of the progression, and another iteration of the progression appears from 0:50 to 1:20. Heard within this time frame are the push and pull of the tempo and a melody that is not quite in time, suggesting an improvisatory style much like the style in "The Strang-

<sup>21</sup> Billy Joel, "Billy Joel Talks About The Beatles Group & it's Band Members - SiriusXM 2016," produced by SiriusXM, May 16, 2016, audio interview, [https://www.youtube.com/watch?v=xTgNo5GhK4s&list=PLCcq\\_CUdaonuHjrnfsjXFlxExsgLqG9uY&index=4](https://www.youtube.com/watch?v=xTgNo5GhK4s&list=PLCcq_CUdaonuHjrnfsjXFlxExsgLqG9uY&index=4).

<sup>22</sup> Joel, "Billy Joel Talks ... Influences."

<sup>23</sup> Joel, "Billy Joel Talks ... Influences."

er.” Another feature common to both tracks is a striking half cadence; a half cadence is a certain harmonic configuration that marks the end of a musical idea but strongly implies continuation of the musical work. In “Try a Little Tenderness,” a half cadence in A minor divides the verse at 0:26 and 1:03. In Spotify’s recording of “The Stranger,” a half cadence in the home key of E minor ends the first phrase in the opening piano solo at 0:22. It is apparent that while there is a contrast in the similarities between the music of Joel and Brubeck, they are no less important. The similar harmonic progression, improvisatory piano performance style, and stunning half cadence truly link “The Stranger” and “Try a Little Tenderness.”

## Rock and Roll and the Beatles

Like many rock musicians, Joel was heavily influenced by the Beatles.<sup>24</sup> Their influence is revealed in Joel’s musical decisions, especially in his most nostalgic songs, including “Miami 2017,” “Goodnight Saigon,” and “Leningrad.” Some of this influence comes out consistently in Joel’s music. For example, amongst other Joel works, “Miami 2017” and “Leningrad” feature a steady pulse provided by piano chords. In both works, the pulse functions as a transition from the piano introduction to the first verse and continues to provide background for Joel’s vocals. This piano pulse is reminiscent of various Beatles’ tracks, including the string pulse in “Eleanor Rigby” and the guitar pulse heard throughout “With A Little Help From My Friends.”

Joel references other, more specific musical elements from the Beatles in his music, including harmonic colors, textural treatments, and singing instrumental lines. An example of the Beatles’ coloristic influence appears in “Miami 2017” within the first, third, fifth, and final verses. Most popular music structures are built on a chord progression, or sequence, of I, IV, V, and vi, or some variation of the pattern.<sup>25</sup> These chords are common because chord progressions establish the home key of a musical work, and these chords most strongly lead the listener back to the home key. Joel begins the second half of these particular verses with a striking iii chord. Instead of leading back to the home key, the chord shifts the listener’s focus away from the home key, adding a distinctive, unexpected color to the song; a piano solo gets the chord at 0:54-57 and 3:54-57 in Spotify’s recording. In the Beatles’ album *Revolver*, “Got to Get You Into My Life” also employs the iii chord to separate the second half of the verse from the first. The chord can be heard at 0:21-27, 0:48-55, and 1:28-34 in Spotify’s re-

<sup>24</sup> Joel, “Billy Joel Talks ... The Beatles.”

<sup>25</sup> Victoria Longdon, “These four chords are at the heart of every pop song,” *Classic FM*, last modified February 28, 2019, accessed May 6, 2020, <https://www.classicfm.com/discover-music/music-theory/four-chords-every-pop-song/>. In a pop song written in C major, the chord symbols of the given Roman numeral progression would be C major, F major, G major, and A minor.

recording. Though the piano solo that opens “Miami 2017” does not include any direct influences from the Beatles, Joel may have gotten the idea for the interesting harmonic color in various verses from the group.

*Joel references other, more specific musical elements from the Beatles in his music, including harmonic colors, textural treatments, and singing instrumental lines.*

“Goodnight Saigon” is also influenced heavily by the music of the Beatles. In interviews, Joel explains how the textural treatment of the Beatles’ “A Day In The Life” impacted the song.<sup>26</sup> He describes the opening of “A Day In The Life” as soft and plaintive, later heading into a big middle section, and he remembers desiring to give the same treatment to “Goodnight Saigon” during the writing process.<sup>27</sup> The two songs do in fact have a very similar form, opening with a slower, smaller section that builds to a grander, more symphonic section, repeating the pattern once more before fading out. “Goodnight Saigon” switches its inspiration’s components around a little bit; Joel opens the song with a calm piano solo that eventually gives way to soft guitar. In contrast, “A Day In The Life” opens with guitar, allows the piano a small taste of the spotlight from 0:06-12 on Spotify’s recording, and reverts back to guitar. When “Goodnight Saigon” first builds to a large section around the time stamp 3:21 in Spotify’s recording, the piano can be heard in interplay with the other instruments during this section and continues similarly after the big section returns to the smaller section. Likewise, piano can be heard in interplay with the other instruments in “A Day In The Life” starting at the first instrumental buildup; this is found at 1:36 in Spotify’s recording. “Goodnight Saigon” is the case study in this discussion that is most explicitly influenced by a particular song.

The final case study, “Leningrad,” may have been influenced by “She’s Leaving Home,” another track off the Beatles’ album, *Sgt. Pepper’s Lonely Hearts Club Band*. “Leningrad” opens with yet another piano solo, this one featuring long phrase lengths and a melodic singing line, before transitioning to piano chords, which are heard throughout the track. Joel’s piano bass line is also quite heavy, a quality heard best from 0:21-48 on the Spotify recording. Like “Leningrad,” “She’s Leaving Home” features long melodic lines, in the strings rather than the piano. It is also another Beatles song that features a constant instrumental pulse; a harp provides

<sup>26</sup> Joel, “Billy Joel Talks ... ‘The Nylon Curtain.’”

<sup>27</sup> Joel, “Billy Joel Talks ... ‘The Nylon Curtain.’”

the pulse from the opening at 0:50 in the Spotify recording before relinquishing the pulse to the strings for the remainder of the song. Lastly, an equivalent to Joel's heavy bass line near the beginning of "Leningrad" can be found in "She's Leaving Home." The heavy use of the cello in "She's Leaving Home" can be heard especially well at 0:12-26, 0:34-40, 1:06-14, 1:24-32, 1:48-52, and 2:20-28 in Spotify's recording. The cello line throughout the track is not quite as low as the piano bass line in "Leningrad," but the prominence of the melodic lower voice is a striking contrast to the higher string hits, much as the heavy bass line is a striking contrast to the higher chordal hits in "Leningrad."

## Conclusion

As described, the musical ideas Joel has gained from the artists who potentially make up his nostalgic soundtrack are numerous. While the connection I've drawn between Joel's music and my dad is deeply personal, the nostalgia that I feel when listening to some of Joel's works occurs even when I'm not listening to a song I specifically remember enjoying with my dad. The semiotic approach that I use and the different gestures I analyze in Joel's music showcase a nostalgia topic, through which Joel's work can be interpreted. The various influential artists that I discussed are all musicians that Joel recalls listening to as an older teen, which is when he would have been making nostalgic connections to music.

*The one commonality is that Joel places his components into the care of the piano, or, in the case of textural play, grants the piano a significant role in creating contrast.*

Elements acquired from such influences range from similarly contoured melodies and comparable harmonic progressions to constant chordal hits and similar styles of performance. In other words, there are few commonalities among the building blocks Joel has received from other artists. The one commonality is that Joel places his components into the care of the piano, or, in the case of textural play, grants the piano a significant role in creating contrast. This myriad of collected elements gathered from Joel's nostalgic soundtrack is consistently revealed through his use of the piano, and it is that fact that leads me to conclude that it is the use of the piano itself, and no one motive or progression it presents, that truly evokes the nostalgia topic in the music of Billy Joel.



## Author's Note

### Kendall Waters

Kendall Waters ('21) is a major in Music with a minor in Jazz Studies. She hopes that more interdisciplinary projects like this work are on the horizon as she pursues a PhD in Musicology and a career as a researcher and music history educator at a university, but she is specifically interested in Spanish and Latin American music within both folk and art music traditions.

Kendall would like to thank Dr. John Peterson for donating his considerable time and expertise to guide revision of the project and the *JMURJ* Editorial Board for their invaluable help preparing the project for publication.

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# Parallel Greedy Triangulation of a Point Set

Eliza Shoemaker and Randy Shoemaker

## Abstract

A greedy triangulation algorithm takes a set of points in the plane and returns a triangulation of the point set. The triangulation is built by adding the smallest line segment between points that does not intersect any line previously in the triangulation. The greedy triangulation is inexpensive computationally and gives an approximation of the minimum-weight triangulation problem, an NP-hard problem, which is computationally expensive. We present serial and parallel implementations of the greedy triangulation using the following approach: once a line is added to the triangulation, all intersecting lines are removed from consideration. This process is repeated until a triangulation is obtained. We present and analyze experimental wall-time data for the serial and parallel implementations. We show that the parallel version has strong and weak scaling properties, and that this algorithm benefits greatly from parallelism.

*Index Terms* - Computation theory, greedy algorithms, parallel algorithms, parallel programming



# Introduction

A greedy triangulation algorithm takes a set of points on a 2D plane and returns a triangulation of the point set. The triangulation is built by adding the smallest line segment between points that does not intersect any line previously in the triangulation. The greedy triangulation gives an approximate solution to the NP-hard minimum-weight triangulation (MWT) problem. As an NP-hard problem, the MWT is computationally expensive: it requires unworkably large amounts of “wall-time” and/or computer processors to arrive at an optimized solution. In contrast, a greedy triangulation algorithm is computationally inexpensive: it requires less actual elapsed time on a very precise clock on the wall—one that measures to .0001 of a second—and/or fewer linked computer processors in a world where most desktop computers have just four processors.

Triangulation is a classic CS problem and a greedy triangulation is one of the simplest and most natural algorithms for triangulation. A solution to the MWT problem is one of CS’s holy grails; more broadly, relatively optimized greedy triangulation approximations for the MWT have applications for graphics, data compression, and database systems. In this paper, we present serial and parallel implementations of the greedy triangulation using the following approach: once a line is added to the triangulation, all intersecting lines are removed from consideration. This process is repeated until a triangulation is obtained. We present and analyze experimental wall-time data for the serial and parallel implementations. We show that the parallel version has strong and weak scaling properties and that this algorithm benefits greatly from parallelism.

## 1. Background

Before discussing the greedy triangulation algorithm and its computational aspects, we must first discuss some relevant concepts. An algorithm is a step-by-step procedure, terminating in a finite amount of time, which specifies how to solve instances of a particular problem. An algorithm has a worst-case complexity of  $O(f(n))$  if the amount of computation needed to carry out the algorithm, in the worst case, grows on the order of  $f(n)$  as the size of the input  $n$  grows. Informally, a problem is considered NP-hard if it is at least as hard to solve as complex problems, such as the travelling salesman problem. In the travelling salesman problem, a list of  $n$  cities and distances between them is given, and the goal is to find a way to visit each city exactly once such that the total distance travelled is minimized. As  $n$  grows, it becomes intractable to find solutions to NP-hard problems. A  $O(f(n))$ -approximation to an NP-hard problem is

a solution where the error between the approximation and the actual solution grows on the order of  $f(n)$  as  $n$  grows, which is relatively manageable or acceptable error.

A triangulation of a set of points is a collection of the points connected by edges such that the edges form triangles. Consider Fig. 1 and the points in Fig. 1a. The steps of the greedy triangulation algorithm can be seen in Fig. 1b through Fig. 1i, where the set of points in Fig. 1a is being triangulated. The greedy triangulation algorithm takes a set of points in the plane and returns a triangulation of the point set.

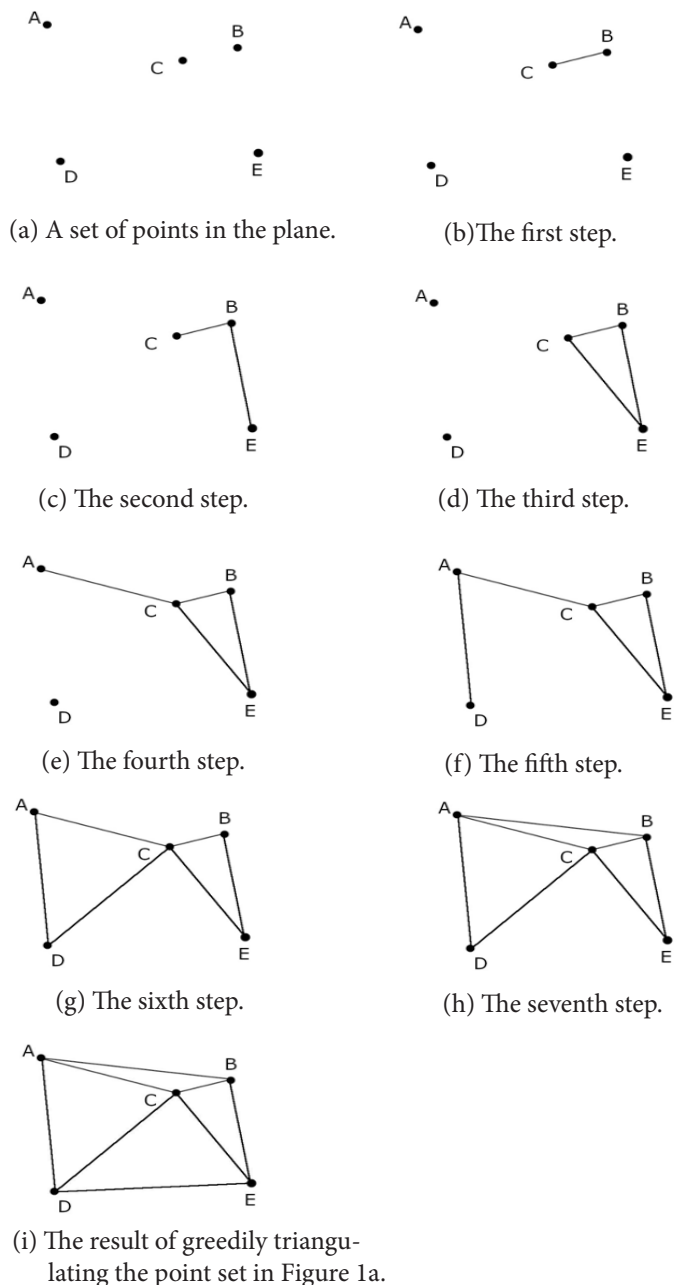


Figure 1. Steps of the greedy triangulation algorithm.

The triangulation is built by adding the smallest line segment between points that does not intersect any line previously in the triangulation. We present serial and parallel implementations of greedy triangulation using the following approach: once a line is added to the triangulation, all intersecting lines are removed from consideration. This process is repeated until a triangulation is obtained.

The greedy triangulation has been an area of research for more than fifty years, in part because it gives an approximation of minimum-weight triangulation (MWT) [1]. The MWT seeks to produce the triangulation of a point set with minimum weight. In this context, the weight of a triangulation is the sum of the lengths of the line segments comprising it. In 2008, Mulzer and Rote [2] proved the MWT problem to be NP-hard, which means that approximations for MWT are desirable. Earlier, Levkopoulos and Krznaric [3] showed that the greedy triangulation gives a  $n$ -approximation of the MWT, where  $n$  is the number of points in the triangulation problem. This means that as the number of points grows, the difference between the greedy solution and the actual solution grows on the order of  $O(n)$  [3].

Dickerson et al. [1] developed an algorithm with an average case complexity of  $O(n)$  to compute the greedy triangulation. Their approach requires the point set to be uniformly distributed within a convex hull. The convex hull of a point set is a polygon formed by connecting the points with straight lines which contains the entire point set within its interior. Drysdale et al. [4] offered an improved  $O(n)$  algorithm that also requires the input set to be uniformly distributed in a convex hull. Levkopoulos and Krznaric [5] showed that the greedy triangulation can be computed in linear time.

Parallel implementations of the greedy triangulation algorithm exist. Jansson [6] developed a parallel version which runs in  $O(n)$  on  $O(n^4)$  processors. This means that as the number of points  $n$  grows, the required number of computer processors grows on the order of  $n^4$ . For large point sets, Jansson's parallel version becomes impractical. For instance, if  $n = 1000$ , Jansson's version would require 1,000,000 processors; a typical desktop computer has four processors. The parallel version presented in this paper is suitable for larger point sets and does not require such a large number of processors. In the following section, we present both the serial and parallel versions of the greedy triangulation algorithm.

## 2. Method

Fig. 2 presents a relatively reader-friendly pseudocode version of the serial algorithm we created using the C

programming language. In this version, if there are  $n$  points in the point set, there are  $\frac{1}{2}n(n-1)$  lines between all points. Thus, it would seem that the serial approach has a worst-case complexity of  $O(n^4)$ , since we may have to check every line against all other lines. However, it is known that this method has a worst-case complexity of  $O(n^3)$  [4]. This is because, once a line is added to the triangulation, all lines which intersect it no longer need to be considered. Thus, as the algorithm progresses, lines are rapidly eliminated.

The serial algorithm consists of three phases: generate, sort, and triangulate. During the generate phase, the  $\frac{1}{2}n(n-1)$  possible line segments are generated, where  $n$  is the number of points in the point set. During the sort phase, the lines are sorted in ascending order according to their length. In our implementation, we used the `qsort` algorithm from the C programming language's standard library of functions to carry out the sort. During the triangulate phase, the triangulation is built by successively adding the smallest line and removing all lines that intersect with it. After all intersecting lines are removed, the new smallest line is selected, and the process repeats. After each line has either been removed or added to the triangulation, the algorithm terminates and returns the triangulation. The approach of the algorithm in Fig. 2 can benefit from parallelism. It is for this reason that we chose to parallelize this algorithm.

Our parallel version of the greedy triangulation algorithm was created by modifying the serial version in the algorithm in Fig. 2. The serial version is a relatively generic algorithm, commonly referred to as a naive solution, as it was simple to come up with and seemed like the most natural solution. The parallel algorithm in Fig. 3 can also be divided into the same phases as the serial version. To achieve parallelization, we made some modifications. A parallel version of the generate phase was created, but experimentation showed that it was slower than the serial version. The generate phase is the same for both the serial and parallel versions, except that the lines generated in the parallel version are distributed to all processes. After the lines are generated, they are divided into subsets of equal size, and each subset is distributed to a process. Each process then carries out the sort phase in parallel. Once each process has sorted its local array of lines, the triangulate phase begins.

During the triangulation, each process finds its smallest line and global communication is used so that each process has a list of the smallest line from each process. Each process then selects the smallest line. The ROOT process, which coordinates the other processes, adds the smallest line to the triangulation, and the process that

```

Input: Planar Point Set  $P$ 
Output: Triangulation  $T$ 
1  $lines \leftarrow \emptyset$ 
2  $n \leftarrow |P|$ 
   // Phase 1: generate all lines
3  $lines \leftarrow$  List of lines from  $P[i]$  to  $P[j]$  for all pairs  $(i, j)$  where  $i < j$ 
   // Phase 2: sort the lines
4 Sort the contents of  $lines$  in ascending order
   // Phase 3: greedily build the triangulation
5  $T \leftarrow \emptyset$ 
6  $unknowns \leftarrow |lines|$  // Number of lines with unknown status
7
8 while  $unknown > 0$  do
9    $l^* \leftarrow lines[0]$ 
10   $T \leftarrow T \cup \{l^*\}$  // Add smallest line to triangulation
11
12   $lines \leftarrow lines - l^*$  // Remove the smallest line from lines
13
14   $unknowns \leftarrow unknowns - 1$ 
   // Remove all lines that intersect with  $l^*$ 
15  for  $l$  in  $lines$  do
16    if  $l$  intersects  $l^*$  then
17       $lines \leftarrow lines - l$  // Remove the intersecting line
18
19       $unknowns \leftarrow unknowns - 1$ 
20 return  $T$ 

```

Figure 2. Serial greedy triangulation algorithm.

```

Input: Planar Point Set  $P$ 
Output: Triangulation  $T$ 
1  $lines \leftarrow \emptyset$ 
2  $n \leftarrow |P|$ 
3  $line\_index \leftarrow 0$ 
   // Phase 1: generate all lines
4 if process is ROOT then
   // Only generate lines on the ROOT process
5
6   for  $i \leftarrow 0$  to  $n$  do
7     for  $j \leftarrow i + 1$  to  $n$  do
8        $lines[index] \leftarrow$  the line from  $P[i]$  to  $p[j]$ 
9        $line\_index \leftarrow line\_index + 1$ 
10 Distribute equal sized subsets of  $lines$  to each process, initialize  $local\_lines$ 
   // Phase 2: sort the lines (in parallel)
11 Sort the contents of  $local\_lines$  on each process in ascending order
   // Phase 3: greedily build the triangulation (in parallel)
12  $T \leftarrow \emptyset$ 
13  $unknowns\_local \leftarrow |local\_lines|$  // Number of lines with unknown status
14
15 while  $unknowns\_local > 0$  do
16    $l\_local^* \leftarrow local\_lines[0]$ 
17    $small\_lines \leftarrow AllGather(l\_local^*)$  // Share smallest line
18
19    $l^* \leftarrow$  smallest line in  $small\_lines$ 
20   if process is ROOT then
21      $T \leftarrow T \cup \{l^*\}$  // Add smallest line to triangulation on ROOT
22
23   if  $l^*$  in  $local\_lines$  then
   // Remove the smallest line from the process's  $local\_lines$  and update its  $unknowns\_local$ 
24      $local\_lines \leftarrow local\_lines - l^*$ 
25      $unknowns\_local \leftarrow unknowns\_local - 1$ 
   // Remove all lines that intersect with  $l^*$ 
26   for  $l$  in  $local\_lines$  do
27     if  $l$  intersects  $l^*$  then
28        $local\_lines \leftarrow local\_lines - l$  // Remove the intersecting line
29
30        $unknowns\_local \leftarrow unknowns\_local - 1$ 
31 return  $T$ 

```

Figure 3. Parallel greedy triangulation algorithm.

has the smallest line removes this line from its list of lines. At this point, each process removes the lines that intersect the smallest line from its list. As in the serial version, this is repeated until each line either belongs to the triangulation or has been removed. The algorithm then returns the triangulation and terminates.

The algorithms were implemented in the programming language C and the Message Passing Interface was used to implement the parallel version. The sorting phase was implemented in both versions using the `qsort` function from the C library.

### 3. Experiments

Experimental results for the serial and parallel versions were conducted on the computer cluster at James Madison University. A computer cluster is a group of interconnected computers that can carry out computations in parallel. The JMU cluster has 16 nodes, each containing 8 processors. We tested both versions using varying sizes of point sets. We present the time taken to carry out all computations, known as the wall-time, for each point set in Tables I, II, and III. Because there are on the order of  $O(n^2)$  lines for  $n$  points, each point set is 707 points times some multiple of  $\sqrt{2}$ . This is because multiplying the number of points by  $\sqrt{2}$  doubles the input size, which is the number of lines. We used 707 points as a baseline because smaller numbers of points yield timings that are small enough to be significantly affected by noise on the cluster. Noise occurs because the same program can run on the cluster many times and take a different amount of time in each instance. While fluctuations are typically on the order of .0001 seconds or less, they create much more noise when experiments use smaller numbers of points. Our experiments used the following numbers of points: 707, 1000, 1414, 2000, 2828, and 4000.

To ensure our analysis was robust, we experimented with varying numbers of processes when testing the parallel version. Our experiments used the following numbers of processes: 1, 2, 4, 8, 16, 32, and 64. We used powers of 2 so we could analyze the behavior to detect both strong and weak scaling, two important concerns that we discuss more fully in our Results section below.

### 4. Results

Tables I, II, and III present the wall-times of the three phases. Each data point is the smallest value observed for that particular entry across 6 trials. The values for the generate phase include the time it took to distribute the points from the ROOT to all other processes.

Before discussing our results, we present some nec-

essary terminology about the significance of scaling. When parallelizing an application, the speedup is measured in two ways: weak scaling and strong scaling. A parallel solution exhibits weak scaling if an increase in the number of processors while holding the problem size constant reduces the run time. A parallel solution exhibits strong scaling if the run time remains constant while the number of processors and problem size increase at the same rate. It is worth noting that weak scaling and strong scaling are independent [7]. Based on the data presented in Tables I, II, and III, we can make the following observations about the three phases of the parallel version:

1. The cost of distributing the lines adds overhead to the generate phase;
2. In general, the sort phase scales both strongly and weakly;
3. The triangulate phase scales strongly and the speedup is significant.

Since the lines must be distributed during the generate phase and the generate phase takes place serially on the ROOT, the wall-time of the parallel version's generate phase is slower. This is because the ROOT must communicate with all other processes. When compared to the wall-time of the entire program, this increase is dwarfed by the benefits of parallelizing the triangulate phase. In Table I, the wall-times for the generate phase for a given input generally decrease as the number of processes is increased from 1 to 2 and from 2 to 4. This is the case because the processes are all running on the same node when the number of processes is less than 8. When the number of processes increases to 8, the wall-time increases because the processes are running on running on more than one node and thus communication is more costly. The overhead costs of the generate phase in terms of elapsed time are offset by the benefits of parallelism for the sort and triangulate phases.

The sort phase scales strongly and weakly. Notice in Table II that, in general, if the number of points in a point set is fixed and the number of processes is doubled, the wall-time is halved. This is why we are justified in asserting that the sorting phase scales weakly. Recall that in order to double the input size we must scale the number of points by  $\sqrt{2}$ . In Table II, the wall-time remains roughly constant as the input size is doubled. This means that the sort phase scales strongly. Even though the sorting phase has nice scaling properties, the benefits to the algorithm as a whole are small because the proportion of the wall-time occupied by the sorting phase is small. It is the triangulate phase that is the most costly and where parallelism has the greatest benefit.

Most of the benefits to the total wall-time of the parallel algorithm come from the triangulate phase, shown in Table III. Just like the sort phase, the triangulate phase scales strongly. The parallel version with one process is slower than the serial version due to overhead, but for a higher number of processes the wall-times are much faster. This phase does not scale weakly; however, the benefits of parallelism are clear. When the point set contains 4000 points, the wall-time for the serial version is about 70 minutes. The parallel version takes less than 3 minutes with 64 processes.

## 5. Discussion

The parallel version of the greedy triangulation algorithm outperforms the serial version. The triangulate phase in particular reaps the most benefits due to parallelism because of the significant reduction in wall-time.

If the scaling trends continue for larger numbers of processes, then it is apparent that large point sets can be triangulated quickly on larger clusters. The speedup analysis shows that this algorithm for the greedy triangulation benefits greatly from parallelism.

## 6. Conclusion

The greedy triangulation algorithm in Fig. 1 benefits greatly from parallelization. The serial and parallel versions consist of three phases: generating the lines, sorting the lines, and producing the triangulation. The parallel version in Fig. 2 has nice scaling properties. While the generate phase is slower due to communication between the ROOT process and the other processes, the sort and triangulate phases are faster. The sorting phase scales both strongly and weakly. The triangulate phase of the serial and parallel versions is the most cost-

Table I. Experimental Results for the Generate Phase in Seconds

Points	Serial	1 P	2 P	4 P	8 P	16 P	32 P	64 P
707	0.0113	0.0522	0.0312	0.0316	0.0193	0.0561	0.0762	0.1097
1000	0.0218	0.1014	0.0602	0.0518	0.0382	0.1109	0.1492	0.1784
1414	0.0429	0.2025	0.1176	0.1136	0.0730	0.2200	0.2955	0.3391
2000	0.0843	0.4433	0.2325	0.2007	0.1938	0.4715	0.5908	0.6798
2828	0.1673	0.7973	0.5070	0.4265	0.3774	0.8694	1.1742	1.3334
4000	0.0330	1.6651	1.1968	0.7969	0.6144	1.7375	2.3577	2.6662

Table II. Experimental Results for the Sort Phase in Seconds

Points	Serial	1 P	2 P	4 P	8 P	16 P	32 P	64 P
707	0.0527	0.0538	0.0266	0.0200	0.0110	0.0053	0.0026	0.0014
1000	0.1087	0.1114	0.0542	0.0415	0.0229	0.0110	0.0054	0.0028
1414	0.2254	0.2668	0.1116	0.0606	0.0329	0.0232	0.0111	0.0054
2000	0.4675	0.5109	0.2329	0.1786	0.0962	0.0473	0.0230	0.0110
2828	0.9667	0.9868	0.4929	0.2660	0.2080	0.0997	0.0479	0.0232
4000	2.0025	2.0816	1.2922	0.6399	0.4286	0.2075	0.0898	0.0483

Table III. Experimental Results for the Triangulate Phase in Seconds

Points	Serial	1 P	2 P	4 P	8 P	16 P	32 P	64 P
707	8.6674	9.3801	4.6939	2.8247	1.7278	1.2628	1.0404	1.2657
1000	26.493	34.767	18.436	10.754	6.1115	3.1537	2.3057	2.3979
1414	93.683	139.72	73.512	40.841	24.744	10.667	5.8319	5.3011
2000	345.38	511.96	259.15	150.19	116.75	43.747	21.820	12.742
2828	1187.1	1841.7	956.47	541.69	386.83	179.37	92.878	46.203
4000	4311.5	6878.5	4347.3	2192.0	1301.9	661.94	333.28	177.73

ly phase of the algorithm. The parallel version scales strongly and allows a triangulation to be computed in a fraction of the time. The speedup for the triangulate phase far outweighs the fact that the generate phase is slower. We conclude that parallelizing the greedy triangulation algorithm as in Fig. 2 is beneficial.

## 7. Future Work

Experiments on larger clusters should be conducted to further illustrate the scaling properties of the parallel implementation presented here. It would be useful to know if these trends continue. It is the authors' contention that the speedup can be improved. One way to improve the performance of the program would be to use multithreading on each process during the generate phases and the triangulate phases. Multithreading involves many processes, sharing a common memory which execute on the same processor. Since the triangulate phase takes the most time, multithreading should be introduced there first. The portion of phase three which is most amenable to multi-threading is removing lines that intersect the line most recently added to the triangulation. Since the intersection of any two lines are independent of any other two lines, this can be carried out efficiently on multiple threads. The line generation phase should benefit from multithreading for the same reason. It would also be beneficial to implement other triangulation algorithms and see how their wall-times compare to the results presented here. Other efforts could include a theoretical analysis of the parallel algorithm and creating implementations of the parallel algorithm to run on recent graphics processing units designed to carry out the same operation on many pieces of data at the same time.

## Author's Note



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Eliza Shoemaker ('19) graduated with a bachelor's degree in Computer Science with a minor in Logic and Reasoning. She is currently working as a software engineer in Eastern Virginia. Eliza enjoys solving puzzles and drinking tea.

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# The Danger of Apathy

## College Students' Receipt of Mumps Vaccine During an Outbreak

Laura A. Keane

### Abstract

A mumps outbreak occurred on the James Madison University campus in Harrisonburg, Virginia, during the Spring 2018 semester. For many students, it was the first time they had to decide on their own whether or not to receive a vaccine. This explanatory, cross-sectional study examined the relationships between students' general vaccine acceptance; measles, mumps, and rubella (MMR) vaccine acceptance; vaccine knowledge; and intent to receive/receipt of the MMR booster. A survey was distributed in Fall 2019 to students in two health courses ( $n = 243$ ). For students enrolled during the Spring 2018 semester, the survey evaluated perceptions and behaviors regarding the MMR vaccine; for those not enrolled in Spring 2018, the survey evaluated perceptions of a hypothetical outbreak. As a whole, the surveyed population had a positive attitude towards vaccines, and 97.4% ( $n = 149$ ) of participants responding to the hypothetical scenario said they would receive a booster shot if recommended when presented the opportunity. Still, attitude alone is not enough to persuade an individual to receive a vaccine. Only 38.1% of the 32 participants enrolled in Spring 2018 elected to receive the MMR vaccine, while 61.9% ( $n = 52$ ) did not receive the vaccine, with the most popular reason being lack of time. The results indicate more efforts are needed to increase the perceived importance of vaccinations and perceived susceptibility to the consequences of not getting vaccinated.

A mumps outbreak occurred on the James Madison University (JMU) campus in Harrisonburg, Virginia, during the Spring 2018 semester. For many of the students, it was the first time they had to decide on their own whether or not to receive a vaccine. In Virginia, as in every other U.S. state, the law requires that parents and guardians of K-12 students provide proof of measles, mumps, and rubella (MMR) immunization before their students can attend public schools (Virginia Department of Health, 2020; Immunization Action Coalition, 2019; Iowa Department of Public Health, 2017); similarly, as in other states, Virginia law requires that all students in public baccalaureate-granting institutions be immunized against measles, mumps, and rubella prior to enrollment (Code of Virginia, n.d.-a).

Even though MMR is a required vaccination for most U.S. college students, mumps outbreaks still occur regularly on college campuses (Marlow et al., 2019). JMU, a mid-sized public state university, experienced a mumps outbreak in Spring 2018, and the *JMU News* website noted that “the Virginia Department of Health, in consultation with the Centers for Disease Control and Prevention, is recommending that students, faculty and staff receive a third dose of the mumps vaccine” (Wyatt, 2018). Free vaccination clinics were hosted by JMU’s University Health Center and the Virginia Department of Health for all members of the JMU community to receive a third booster MMR vaccine (Wyatt, 2018).

This study investigated the behaviors and perceptions of college-aged students regarding their decision to receive or not receive the MMR vaccine booster through a series of questionnaires from validated instruments.

## Literature Review

### The MMR Vaccine and Mumps

The MMR vaccine was approved for use in the United States by the Food and Drug Administration (FDA) in 1971 and as a two-dose sequence is 88% effective against mumps (CDC, 2020a; CDC, 2019b). The CDC (2020b) recommends that the first dose in the sequence be administered to children at 12–15 months of age and the second dose before kindergarten, when children are 4–6 years old. In 2017, 91.1% of children in the United States and 97.6% of children in Virginia aged 19–35 months received the MMR vaccine (CDC, 2018a, 2018c). When a mumps outbreak occurs, the CDC (2019b) notes that public health authorities might recommend a third booster dose to higher-risk groups. During an outbreak, a third dose of the MMR vaccine can help prevent spread as evidence shows lower infection rates among those who receive the booster than those who do not (Nelson et al., 2013; Ogbuanu et al., 2012; CDC, 2018b).

Mumps is transmitted through saliva droplets with patients initially presenting with swollen salivary glands, fevers, muscle aches, headaches, and fatigue (CDC, 2019c). Affected individuals show symptoms 12–25 days after exposure and are contagious days before and up to five days after salivary gland swelling begins (CDC, 2019d). Complications such as testicular swelling, encephalitis, meningitis, miscarriage, arthritis, deafness, pancreatitis, or orchitis can occur (CDC, 2019a).

### Child Vaccine Uptake and Refusal

Reasons parents vaccinate their children are due to altruism, bandwagoning, and the perception that not receiving a vaccine is worse than receiving it (Poland & Jacobson, 2001).

Legally acceptable reasons for not vaccinating before school enrollment must be medical, religious, or philosophical (National Conference of State Legislation, 2019). Similarly, Virginia Law §22.1-271.2 allows vaccine refusal for medical reasons or if vaccination goes against an individual’s religious beliefs/practices (Code of Virginia, n.d.-b). The CDC (2018b) recommends that individuals with allergies, weakened immune systems from cancer or HIV/AIDS, tuberculosis, conditions causing bleeding or bruising easily, a history of immune disorders, or who are pregnant should avoid receiving the MMR vaccine.

In a 2001 study of 1,600 parents of children under 6 years old in the United States, 25% of parents believed a child’s immune system was weakened by too many vaccines, while only 23% believed the more immunizations their children received the better it was for their health (Poland & Jacobson, 2001). In this study, parents’ main reason for not vaccinating their children was based on omission bias: where omission bias refers to the belief that “a bad outcome is worse if it occurred due to an active choice to do something rather than as a consequence of not doing something” (Poland & Jacobson, 2001, p. 2443).

Smith et al. (2008) found that non-Hispanic Black children, children who had siblings, children who lived outside the Northeast region, and children who went to public health clinics were less likely to receive the MMR vaccine. Children of single mothers and children of mothers with relatively less education were also less likely to receive the MMR vaccination (Smith et al., 2008).

Wakefield et al. (1998) sparked opposition to the MMR vaccine with a since-retracted study linking MMR vaccination to late onset autism spectrum disorder and bow-



el disease. In 1998, when the article first came out, MMR vaccine refusal was at 8% (Smith et al., 2008). In 2000, the Wakefield et al. article received a lot of undue media attention, and vaccine refusal rose to 10%, the highest refusal rate between 1995-2004 (Dannetun et al., 2005). It is now established the study was flawed with falsified data (Rao & Andrade, 2011).

### Adult Vaccine Uptake and Refusal

Raude et al. (2010) found that out of 275 people, the majority opting to receive a vaccine in France did so for self-protection at 45%, followed by protecting significant others at 28%. Bonfiglioli et al. (2013) found Italian health care workers received vaccines based on knowledge level and age. In contrast, Galarce et al. (2010) found that perceived vaccine safety was the best vaccine predictor.

Factors influencing decisions to vaccinate include socioeconomic status, knowledge of the vaccine, and family/friend influence (Evans et al., 2001; Larson et al., 2001; Topuzoglu et al., 2005). Topuzoglu et al. (2005) found the higher the socioeconomic status, the more likely individuals were to receive a vaccine. In British focus groups, beliefs regarding risks and benefits associated with vaccination, confidence and trust in their health care provider, media influence, and government policy all affected participants' vaccination choices (Evans et al., 2001). When parents were asked about factors that influenced them to vaccinate their children, media influence was second only to school requirements (Dorell et al., 2010). Larson et al. (2014) found social norms, peer influence, and the quality of participants' health knowledge to be influential.

In the past, when more people witnessed the consequences of infectious diseases, like smallpox and polio, vaccination was held at a higher standard (Ehreth, 2003). More recently, individuals have not perceived the risk these pathogens carry, and many choose not to vaccinate even with high infection rates (Ehreth, 2003). Other reasons for vaccine refusal include distrust in public health officials, fears of adverse side effects, and uncertainty regarding effectiveness (Galarce et al., 2010). When individuals choose to not receive a vaccine, they increase the chances of pathogens mutating and reduce the chances of eradicating infectious diseases by lowering herd immunity (Andre, 2003; Ehreth, 2003).

### College Student Vaccine Uptake and Refusal

The University of Missouri surveyed 296 students about behaviors on the H1N1 vaccine and concluded vaccine efficacy followed by disease severity were most

influential in receiving vaccines (Ravert et al., 2012). In a later study, it was found that among female college students, knowledge and perceived susceptibility had the biggest impact on vaccination decisions (You et al., 2020). Demographics, vaccine beliefs, and vaccine information had no clear influence on decisions, as multiple studies displayed mixed results (Evans et al., 2001; Larson et al., 2014; You et al., 2020).

## Research Questions

After reviewing the literature surrounding vaccination, it is evident that more research needs to be collected on additional populations and motives, particularly during a mumps outbreak. There is limited information on college students and vaccinations, given that most of their vaccines are completed by the time they enter college. Recent literature focuses on what motivates parents to vaccinate their children and the effects of receiving a third MMR shot during an outbreak, rather than on what influences college-aged students as they decide whether to receive vaccinations. To understand the motivations behind college-aged students' vaccination decisions when they were confronted with an imminent threat, the current study asked the following research questions:

1. What were college students' motivations to receive/not receive a third MMR booster post-outbreak?
2. Does vaccine acceptance differ between individuals who did/would receive the vaccine and those who did/would not?
3. Do perceptions of the MMR vaccine differ between individuals who did/would receive the vaccine and those who did/would not?

## Methodology

### Study Design

An explanatory, cross-sectional study was conducted from September through October of 2019 using Qualtrics. The questionnaire evaluated undergraduates' perceptions and behaviors related to receiving the MMR vaccine during an outbreak through closed-ended questions. Students not present during the Spring 2018 mumps outbreak at JMU were assessed regarding their perceptions of a hypothetical outbreak.

### Sampling

After being approved by JMU's Institutional Review Board, the online survey was distributed to all ~320 students enrolled in General Education Health courses. Participants in this convenience sample had a week to fill out the survey, and extra credit was offered for

participation. If participants did not want to complete the survey, extra credit was offered in the form of an alternative assignment.

Of the 243 surveys completed, 37.0% of participants ( $n = 90$ ) were enrolled and 63.0% of participants ( $n = 153$ ) were not enrolled at JMU during Spring 2018 when the mumps outbreak occurred. Over half the participants were freshmen (51.0%,  $n = 124$ ), while 12.8% were sophomores ( $n = 31$ ), 28.4% were juniors ( $n = 69$ ), and 7.0% were seniors ( $n = 17$ ). Two participants did not answer the question regarding their academic year. The majority of participants (63.0%,  $n = 153$ ) were in a health-related major or minor, leaving 36.2% ( $n = 88$ ) of participants with a non-health-related major or minor. Two participants did not answer the question regarding major. Individuals who identified as female accounted for 78.6% ( $n = 191$ ) of responses, while individuals who identified as male accounted for 18.7% ( $n = 45$ ) of responses. Individuals who identified as non-binary accounted for 0.8% ( $n = 2$ ) of responses; 1.2% ( $n = 3$ ) chose not to specify gender identity and .8% ( $n = 2$ ) did not answer the question.

## Instruments and Scoring

The questionnaire administered to all participants was drawn from three different instruments, with additional questions created by the researcher.

### Attitudes

A 12-item Vaccine Attitude Examination Scale developed by Martin and Petrie (2017) measured attitudes of college students on vaccinations. This questionnaire was formatted as 12 Likert scale questions asking participants to rank how they feel about vaccinations. Scoring was completed by summing all responses (minimum = 12; maximum = 72). The first three questions employ reverse coding, with higher scores indicating a higher anti-vaccine attitude. Martin and Petrie (2017) tested for test-retest reliability, reporting a Cronbach's alpha of 0.91 and an  $r$  value of 0.84.

### Knowledge

An 11-item questionnaire developed by Zingg and Siegrist (2012) measured college-aged students' knowledge about vaccinations. The questionnaire was formatted as 11 multiple choice questions asking participants to identify what they believed regarding vaccination. A score of 1 was recorded for each correct response and a score of 0 for each incorrect or unknown response. Questions 1, 4, 5, 7, and 9 were reverse coded. The total score was computed by summing the number of correct responses, with higher scores indicating higher knowledge of vaccines. Zingg and Siegrist (2012) tested for test-retest reliability, reporting an  $r$  value of 0.70.

## MMR Beliefs

A 20-item Measles, Mumps and Rubella Vaccination Survey developed by Hamilton-West in 2006 measured attitudes of college students specifically regarding the MMR vaccination. The survey was formatted as 20 Likert scale questions. Responses ranged from 1–5 with possible summed response scores ranging from 20–100. Questions 2, 4, 6, 8, 10, 12, 14, 16, 18, 19, and 20 were reverse coded, and all questions were summed, with higher scores indicating greater MMR acceptance. Hamilton-West (2006) reported a Cronbach's alpha of 0.7 for the scale.

## Vaccination Reasons

The two questions developed were based on data collected by Raude et al. (2010), who reported on reasons why persons over the age of 16 received or did not receive vaccinations for H1N1 (e.g., self-protection, required by work, lack of time). These researcher-developed MMR-focused multiple choice questions asked participants to identify the primary reasons why they received or did not receive the MMR vaccination. Participants were directed to different versions of the questions based on whether they had the option to receive the vaccine in 2018.

## Influences

A question developed by the researcher was based on Dorell et al. (2010), who in turn drew on the CDC's 2010 National Immunization Survey. The researcher-developed, MMR-focused multiple choice question asked participants to identify which factors influenced their decision to receive or not receive a vaccination (e.g., school requirements, TV/media, parents' attitudes, news coverage, religious influences). Participants were directed to an appropriate question on the questionnaire based on whether they had the option to receive the vaccine in 2018.

## Results

Frequencies were analyzed to identify how much of the surveyed population fit into particular categories and were used to examine vaccination reasons and influences for survey participants who did or did not and would or would not receive a MMR vaccine. Frequencies were performed for gender, year in school, health-related major or minor, JMU enrollment status in Spring 2018, willingness to receive the vaccine, vaccine receipt, reasons enrolled participants did/did not get vaccinated, hypothetical reasons unenrolled participants would/would not get vaccinated. Descriptive statistical analysis was performed to identify a minimum, maximum, mean, and standard deviation for the Vaccine Knowledge scale, vaccine attitudes scale, and MMR Attitudes Scale.

Among enrolled students at the time of the outbreak, independent *t*-tests were run to compare vaccination attitudes, MMR vaccine acceptance, and MMR vaccine perceptions between students who did and did not receive the vaccine. Among students not enrolled during the outbreak, independent *t*-tests were run to compare vaccination attitudes, MMR vaccine acceptance, and MMR vaccine perceptions between students who believe they would or would not receive the vaccine in the event of an outbreak. A *p* value  $\leq 0.05$  was considered to be statistically significant for all tests.

Of the 153 participants not enrolled at JMU during the spring semester of 2018, 149 (97.4%) reported they would receive a booster MMR shot if an outbreak occurred and the booster shot was provided for free on JMU's campus. The main reason they would vaccinate was for self-protection (79.2%, *n* = 118), followed by trust in the vaccine/compliance with the recommendation (11.4%, *n* = 17), requirement of major, work, school (6.7%, *n* = 10), and protection of others (2.7%, *n* = 4; see Table 1). The four participants (2.6%) who said they would not receive the vaccine each identified different reasons for their choice: belief the vaccine is dangerous, belief they already had the disease, preference for alternative methods of prevention, and distrust of media and pharmaceuticals.

Of the 90 participants who were present at JMU in the spring of 2018, 88 answered the question about whether they received the MMR vaccine, and 84 were eligible to receive the vaccine. Only 38.1% of participants who were present and eligible to receive MMR actually received the vaccine (*n* = 32), and 61.9% participants (*n* = 52) eligible to receive the vaccine did not receive the vaccine. Those who chose to receive the vaccine did so primarily for self-protection (51.5%, *n* = 17), followed by a requirement by major, work or school (21.2%, *n* = 7) and trust in the vaccine (21.2%, *n* = 7) (see Table 1). Two participants (6.1%) received the vaccine for other reasons. Fifty-two participants did not receive the vaccine, with the most popular reason being they did not have time (59.6%, *n* = 31), followed by the belief they were not at risk of contracting the mumps (9.7%, *n* = 5), belief the vaccine is dangerous (1.7%, *n* = 1), preference for alternative method of prevention %, *n* = 1), and medical or lay recommendation against the vaccine (1.7%, *n* = 1). In the option for "other," nine participants either wrote "didn't care enough to get one," "fear of needles outweighs fear of mumps/death," or "my doctor recommended against getting the mumps booster" (17.3%, *n* = 9). Four participants claimed they were unaware of the outbreak or the location of vaccine clinics (7.8%, *n* = 4).

Table 1. *Reasons for Vaccine Uptake*

Group	Enrolled	Not Enrolled	Total
Self Protection	17	118	135
Trust in the vaccine; compliance with recommendation	7	17	24
Required by work, major, or school	7	10	17
Protection of Others	2	4	6
Total	33	149	182

The participants were knowledgeable about vaccines and vaccine use with a mean of 9.1 questions being answered correctly out of 11.0 (*SD* = 2.0). For vaccine attitudes, the mean was 31.9 out of a scale of 58.0 (*SD* = 11.2), indicating participants were somewhat accepting of vaccines. MMR attitudes had a mean of 69.7 out of a scale of 98.0 (*SD* = 10.6), indicating relatively high levels of vaccine acceptance. Independent *t*-tests were used to compare differences in vaccine attitudes, MMR attitudes, and vaccine knowledge by vaccine receipt or hypothetical receipt. Those who would receive the vaccine had lower scores on the vaccine attitudes scale (*M* = 32.0, *SD* = 10.1) than those who would not receive the vaccine (*M* = 53.0, *SD* = 6.4),  $t(148) = -4.1, p < .001$ , indicating more positive attitudes towards vaccines among those who would get vaccinated. Students who would get vaccinated had significantly higher scores on the MMR attitudes scale (*M* = 68.3, *SD* = 9.7) compared to students who would not get vaccinated (*M* = 52.3, *SD* = 4.5),  $t(143) = 2.8, p < .01$ , indicating more positive MMR attitudes among those who would receive the vaccine. Knowledge scores between those who would and would not vaccinate could not be

compared, as too few individuals who would not vaccinate did not complete the knowledge questionnaire.

Among students enrolled at JMU during the outbreak, those who received the vaccine had lower scores on the vaccine attitudes scale ( $M = 28.1, SD = 12.0$ ) than those who would not receive the vaccine ( $M = 32.3, SD = 12.0$ ),  $t(85) = -1.6, p = 0.114$ , indicating more positive attitudes towards vaccines among those who received the vaccination; however, this difference was not significant. Vaccine Attitude Examination Scale results demonstrated students who vaccinated had significantly higher scores on the MMR attitudes scale ( $M = 77.6, SD = 11.5$ ) compared to students who did not get vaccinated ( $M = 69.7, SD = 10.0$ ),  $t(77) = 3.2, p = .002$ , indicating more positive MMR attitudes among those who received the vaccine. Students who vaccinated had lower scores on the knowledge scale ( $M = 9.2, SD = 1.8$ ) compared to students who did not get vaccinated ( $M = 9.5, SD = 1.4$ ),  $t(21) = -0.507, p = 0.617$ ; however, this was not statistically significant. All scales and results are shown in Table 2.

Table 2. Descriptive Statistics and Mean Differences

		Vaccine Attitudes Scale	MMR Attitudes Scale	Knowledge Scale
Enrolled <i>M (SD)</i>	Received Vaccine	28.1 (12.0)	77.6 (11.5)	9.2 (1.8)
	No Vaccination	32.3 (12.0)	69.7 (10.0)	9.5 (1.4)
Mean Difference		4.2	7.9*	0.3
Not Enrolled <i>M (SD)</i>	Would Vaccinate	32.0 (10.1)	68.3 (9.7)	
	Would Not Vaccinate	53.0 (6.4)	52.3 (4.5)	
Mean Difference		21.0*	16.0*	

For those enrolled at JMU during the outbreak, a chi-square test was run to determine if enrollment in a health-related major (e.g., Health Sciences, Dietetics, Nursing) had any influence on receiving a vaccine. There was no significant relationship in being enrolled in a health-related major when choosing to receive a vaccine ( $p = .518$ ), suggesting that they were no more likely to get the vaccine than those enrolled in a different discipline. For those not enrolled during the outbreak, there was no statistical significance between students in different majors in their decisions to receive a vaccine ( $p = .655$ ) (see Table 3).

Table 3. Chi Square of Major Compared to Vaccine Uptake for Students Both Enrolled and Unenrolled at Time of Vaccine Distribution.

Group	Would/Did Receive Vaccine	Would Not/Did Not Receive Vaccine	Total
Health Major- Enrolled	27	5	29
Non Health Major- Enrolled	44	10	54
Health Major- Unenrolled	78	71	149
Non Health Major- Unenrolled	2	2	4

Note. Enrolled =  $\chi^2 (88) = 0.072, p = 0.518$ ; unenrolled =  $\chi^2 (153) = 0.009, p = 0.655$ .

## Conclusion and Discussion

This study examined the relationships between general vaccine acceptance, MMR vaccine acceptance, vaccine knowledge, and intent to receive/receipt of the MMR among college-aged students. Participants said they would receive MMR boosters given a campus outbreak, but only 36.1% of the participants present at JMU during the outbreak received the vaccine when presented the opportunity. Attitudes were significantly different between participants who were and were not enrolled during the outbreak; however, among those enrolled during the outbreak, MMR attitudes scores were similar, if not higher, than the non-enrolled group, but uptake of vaccination was low. When asked why they did not receive the vaccine, 59.6% of eligible participants present at JMU during the outbreak cited lack of time as the main reason. Of the individuals who received the vaccine, most did so for self-protection, which supports the findings from the Raude et al. (2010) study. The at-

titude scale of vaccines demonstrated the overall population was accepting of vaccines. While attitudes were more positive among those who received the vaccine, it seemed it is not enough to persuade an individual to vaccinate. Vaccine attitudes were slightly higher among those who vaccinated in the enrolled group compared to those who would vaccinate in the unenrolled group; however, the proportion who actually vaccinated was substantially less than those who said they would.

Interestingly, participants in a health-related major were no more likely than other majors to receive a vaccine. Few studies can be found regarding if this is common or unique to JMU; however, a study researching vaccine acceptance of the Dengue vaccine found farmers were more likely to receive a vaccine than employees with private employment and entrepreneurs (Harapan et al., 2016). Another study focused on the uptake of a hypothetical Ebola virus vaccine and found socioeconomic status (including occupation) was not consistent in determining vaccine uptake (Harapan et al., 2017). They found there were multiple variables affecting vaccine uptake decisions (Harapan et al., 2017). In addition to vaccine uptake being similar in non-health majors, the vaccine knowledge scale was lower for students in a health-related major than those not in health-related majors. This relatively low number is surprising as students enrolled in health-related majors are learning about vaccines and would be expected to know more about their importance and effects. The finding further suggests knowledge and exposure to information on vaccine effects do not spur action. Several studies were found relating to knowledge and vaccine uptake but were focused on health care professionals and medical students who were likely required to receive the vaccine by their program or work, making these studies inapplicable (Haridi et al., 2017; Looijmans-van den Akker et al., 2009).

While several studies have found vaccine knowledge plays an important role in uptake, apathy has been noted as a concern. A study using focus groups of college-aged males regarding the HPV vaccine found the males were dismissive, apathetic, and lacked awareness/knowledge of the vaccine, leading to a decreased uptake (Stanley et al., 2018). The difference in male versus female uptake was not looked at in the current study due to the disproportionate response rate regarding gender identity. Apathy has also been shown to play a role in low uptake of flu vaccines (Canning et al., 2005). In the current study, young, legally independent adults were dismissive toward the MMR vaccine, as they did not make time for it. More education and efforts are needed to increase the uptake in vaccines in this population. Previous studies

on increasing vaccine uptake found healthcare professionals' opinions/recommendations have little impact while parental attitudes and knowledge have the most impact (Carter & Jones, 1985; Blyth et al., 2014).

## Limitations

This study is not generalizable to other settings due to the small sample size and convenience sampling, with survey recipients drawn exclusively from Health 100 courses that count toward both a General Education requirement and the Health Sciences major. Obtaining a proportionate sample of students that were enrolled at JMU during the Spring 2018 semester was a limitation that may have decreased the significance and accuracy of the results. The survey had a higher percentage of female respondents in comparison to male respondents (78.6% female vs. 18.7% male), but while disproportionate, JMU has more female students enrolled (58%) than males (42%) (James Madison University, 2020). Another major limitation in the study was including participants who were not enrolled at JMU during the time of the outbreak, limiting data collection to vaccine intentions only. A larger sample size of students who were enrolled during the outbreak would have increased the accuracy of the results. There is also the concern of recall bias, as the outbreak occurred two years before the survey was administered.

## Suggestions for Future Research

Further research needs to be conducted at other universities in the United States where a vaccine can prevent the progression of disease outbreak. Future studies should use larger sample sizes to increase generalizability and measure attitudes using the Health Belief Model, which was developed to explain and predict health-related behaviors typically related to health services. Future research is needed to develop and assess methods of decreasing student indifference toward vaccines and increasing uptake. On a college campus, vaccine uptake can increase by expanding clinic hours to accommodate classes schedules, allowing excused absences if students are scheduled for a vaccine, increased encouragement and education from professors and staff about the vaccine, clinics in more accessible areas, and more vaccination locations rather than just one.

Table 4. Final Results

Variable	Test	Enrolled at Outbreak	Hypothetical Scenario
Vaccination Reason	Descriptive Statistics	36.1% received the vaccine 61.9% did not receive the vaccine	97.4% said would receive the vaccine if offered 2.6% said would not receive the vaccine
Influences	Descriptive Statistics	Vaccinated reasons: Self-protection: 51.5%, Requirement of major, work, school: 21.2%, Trust in the vaccine: 21.2%, Other: 6.1%  Not vaccinated reasons: Did not have time: 55.4%, Belief not at risk of contracting: 8.9%, Belief vaccine is dangerous: 1.8%, Preference for alternative method of prevention: 1.8%, Medical or lay recommendation against the vaccine: 1.8%	Vaccinated reasons: Self-protection: 79.2%, Trust in vaccine/compliance in the recommendation: 11.4%, Requirement of major, work, school: 6.7%, Protection of others: 2.7%  Not vaccinated reasons: Belief the vaccine is dangerous: 25%, Belief they already had the disease: 25%, Preference for alternative method of prevention: 25%, Distrust of media, pharmaceuticals: 25%
Attitude	Independent <i>t</i> -test	Those who received the vaccine had lower scores ( $M = 28.1, SD = 12.0$ ) than those who would not receive the vaccine ( $M = 32.3, SD = 12.0$ ), $t(85) = -1.6, p = 0.114$	Those who would receive the vaccine had lower scores ( $M = 32.0, SD = 10.1$ ) than those who would not receive the vaccine ( $M = 53.0, SD = 6.4$ ), $t(148) = -4.1, p < .001$
Knowledge	Independent <i>t</i> -test	Students who vaccinated had lower scores ( $M = 9.2, SD = 1.8$ ) than students who did not get vaccinated ( $M = 9.5, SD = 1.4$ ), $t(21) = -0.507, p = 0.617$	Too few respondents
MMR Beliefs	Independent <i>t</i> -test	Students who vaccinated had higher scores ( $M = 77.6, SD = 11.5$ ) than students who did not get vaccinated ( $M = 69.7, SD = 10.0$ ), $t(77) = 3.2, p = .002$	Those who would get vaccinated had higher scores on the MMR attitudes scale ( $M = 68.3, SD = 9.7$ ) compared to students who would not get vaccinated ( $M = 52.3, SD = 4.5$ ), $t(143) = 2.8, p < .01$



## Author's Note

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Laura A. Keane ('20) graduated magna cum laude with a degree in Health Sciences and minors in Biology, Pre-Physician Assistant, and Honors Interdisciplinary Studies. She is currently in the Physician Assistant Master's Program at James Madison University and will graduate in December 2022. Laura is grateful to Dr. Sarah Blackstone and the Honors College for all the guidance, advice, and encouragement. She would also like to thank the *JMURJ* Editorial Board for their dedication and support throughout the publication process.

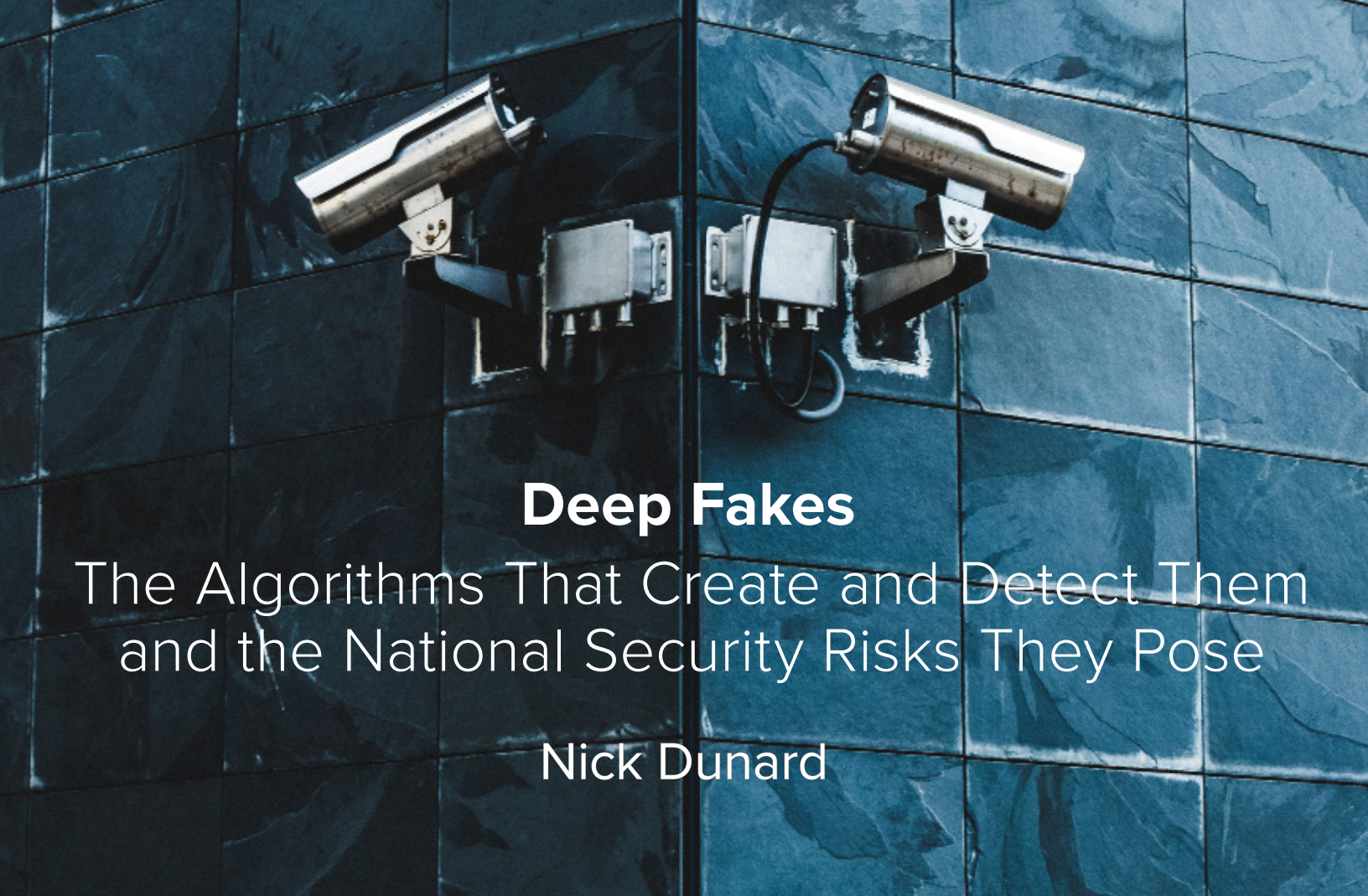
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# Deep Fakes

## The Algorithms That Create and Detect Them and the National Security Risks They Pose

Nick Dunard

### Abstract

The dissemination of deep fakes for nefarious purposes poses significant national security risks to the United States, requiring an urgent development of technologies to detect their use and strategies to mitigate their effects. Deep fakes are images and videos created by or with the assistance of AI algorithms in which a person's likeness, actions, or words have been replaced by someone else's to deceive an audience. Often created with the help of generative adversarial networks, deep fakes can be used to blackmail, harass, exploit, and intimidate individuals and businesses; in large-scale disinformation campaigns, they can incite political tensions around the world and within the U.S. Their broader implication is a deepening challenge to truth in public discourse. The U.S. government, independent researchers, and private companies must collaborate to improve the effectiveness and generalizability of detection methods that can stop the spread of deep fakes.

Keywords: deep fakes, artificial intelligence, machine learning, generative adversarial networks, national security, disinformation, foreign influence operations

The dissemination of deep fakes for nefarious purposes poses significant national security risks to the United States, requiring an urgent development of technologies to detect their use and strategies to mitigate their effects in the public sphere. Deep fakes are images or videos in which a person's likeness, actions, or words have been replaced by someone else's. Deep fakes illustrate how many of the newest national security threats that the United States faces are becoming more technologically advanced and more accessible and easier to operate by motivated individuals and groups.

An interconnected global population and the prevalence of smartphones and social media have enabled unprecedented communication and access to information; these technologies have also opened up new avenues of attack. Known as "disinformation tactics," the threats take many forms, including social media bot networks, fake news stories, blackmail, hacking campaigns, and deep fakes. Disinformation tactics meant to attack an individual or the public's consumption of information and understanding of the world are not new; however, new technologies have allowed their effects to become more widespread and harmful. It is likely that deep fakes will be used in disinformation campaigns by nation state adversaries like Russia and China.

***Deep fakes have the potential in both domestic and foreign contexts to sow discord, spread misinformation, damage reputations, and otherwise harm the interests of the United States.***

Deep fakes have the potential in both domestic and foreign contexts to sow discord, spread misinformation, damage reputations, and otherwise harm the interests of the United States. Domestically, deep fakes pose a threat to U.S. political and economic processes by targeting specific politicians, business leaders, companies, and news events. They also have a high potential to be used in areas with less technological literacy and areas under less scrutiny by the U.S., where false information can spread for longer periods without being detected. Countering disinformation campaigns and other malicious attacks that utilize deep fakes will require more than just detection methods. Education and communication with the public will need to be part of any counteraction effort. It is in the best interests of the Intelligence Community to understand how deep fakes could be used and how they can be countered.

The artificial intelligence (AI) algorithms and other programs used to create deep fakes become more sophisticated every day, improving their ability to create realis-

tic photos and videos and hampering efforts to create detection algorithms and other countermeasures. Government organizations, independent researchers, and private companies have made significant progress in detecting deep fakes; however, their work has lagged behind the pace with which deep fakes are being developed. There are opportunities to create better, more generalized detection methods to combat the harmful effects of deep fakes.

## Deep Fake Creation

Deep fakes are images and videos created by or with the assistance of AI algorithms to deceive an audience. A deep fake could be a realistic photo of a human who does not actually exist, or a video of a public figure saying or doing something they did not actually say or do. The AI algorithms that create deep fakes differ in many ways from the more common applications that AI and machine learning have in our lives. The goal of AI is to create programs able to "learn" in order to solve problems that would ordinarily be too difficult for a computer. AI programs may be presented with data which they learn from to make predictions about previously unseen but related data. For example, a simple AI program may be trained to classify the species of an iris flower. The program does this by learning the features of the data set, in this case the lengths and widths of the petals and sepals, and then using that information to make informed predictions about a new data set. Deep fake creation differs in that the AI does not make a prediction about new data presented to it; instead, it creates new data. These algorithms are known as generative adversarial networks (GANs), and recent innovations have spurred research and development, leading to the emergence of deep fakes

## Neural Networks and GANs

The recent history of deep fakes begins with the development of artificial neural networks (ANNs). An ANN is a machine learning model based upon a network of neurons similar to those in the human brain. In the brain, neurons transmit information by producing electrical impulses called action potentials which release neurotransmitters. When a neuron receives enough of these neurotransmitters, it releases its own action potentials, or inhibits itself, instead not firing. These neurons are connected in large networks, allowing complex calculations to be completed. ANNs use this same architecture by connecting networks of artificial neurons which compute huge numbers of possible combinations depending on whether their inputs and outputs are active or not. Today, artificial neural networks are used by businesses and researchers to accomplish highly

complex data-intensive tasks such as classifying images, text, and speech.

Building upon ANNs, convolutional neural networks (CNNs) model the ways that the visual cortex processes images to accomplish computer image recognition. Psychologists David H. Hubel and Torsten Wiesel discovered the structure and inner workings of the visual cortex by conducting experiments on cats in 1958 and 1959. Two of their most important discoveries were that many neurons in the visual cortex have small local receptive fields, meaning that they only react to stimuli within a certain region of the visual field, and that some neurons only fire in response to certain orientations of lines and objects while not firing for others. For computer vision and image recognition using CNNs, these discoveries mean that individual neurons in the network do not have to be connected to each other; instead, convolutional layers are used, where neurons only examine and respond to the parts of an image in their receptive fields. This architecture is important for image recognition because of the high number of pixels in any given image. Artificial and convolutional neural networks are the backbone of deep learning programs and inform the algorithms that create deep fakes today: generative adversarial networks.

***Artificial and convolutional neural networks are the backbone of deep learning programs and inform the algorithms that create deep fakes today: generative adversarial networks.***

Generative adversarial networks were proposed in 2014 by Goodfellow et al. and have ushered in a new era of deep learning research and experimentation, as well as the creation of deep fakes. Goodfellow et al. proposed a new type of generative machine learning model comprised of two competing models: a generative model and a discriminative model. The generative and discriminative models are both neural networks, and if the task is related to image data, it is likely that they are both CNNs. The purpose of the discriminative model is to determine if a sample presented to it, such as an image, is part of an original, real data set, or if it was created by the generative model. The generative model's purpose is to create new samples that could have come from the original, real data set. The models are trained in competition with each other, where the discriminative model attempts to minimize the amount of errors it makes in distinguishing "real" data from "fake" data, and the generative model attempts to maximize that error in the discriminator by creating increasingly better fakes. Since the initial proposal by Goodfellow

et al., there has been a surge in research to improve the architecture, efficiency, and realism with which GANs can produce images.

***In 2016, Yann Lecun, the VP and Chief AI Scientist at Facebook, described GANs as "the coolest idea in deep learning in the past 20 years."***

The idea of placing two neural networks in competition with each other is the most innovative aspect of GANs, as each network improves the other over time. In 2016, Yann Lecun, the VP and Chief AI Scientist at Facebook, described GANs as "the coolest idea in deep learning in the past 20 years." While Goodfellow et al.'s GAN framework was revolutionary, the initial capabilities were quite limited, as the images it generated were very low resolution and often grainy or fuzzy. Three frameworks that have improved the image quality and training stability of GANs since 2014 are deep convolutional GANs, least squares GANs, and StyleGAN. These frameworks are used in the creation of deep fakes, reducing noticeable errors and improving their realism.

### **Deep Fake Creation with GANs**

In practice, if a GAN were trained to generate pictures of cats, the discriminative model would be trained to recognize a cat by using a large data set of different pictures of cats. The generative model would then attempt to create an image that looks like a cat using only random inputs called "noise." At the beginning of the process, the generative model would not be very effective, and the discriminative model would have a high prediction rate between fake and real. As the generative model learns more and more about what the discriminative model looks for to determine if an image is a cat, it can improve its creation of fake cat images. The generative model never actually sees the pictures it creates. Instead, it learns the most important features of the images from information passed by the discriminator tasked with determining whether images are fake or real.

Generative models can be used to produce three main types of deep fake videos: face-swap, lip-sync, and puppet-master. Face-swap videos, which replace a face with another person's face, are the easiest and lowest quality deep fake to produce. Mobile applications such as Snapchat have had similar features for years, and face-swapping is often obvious, as there is usually little done to maintain consistencies such as face movements and position. Lip-sync videos use existing videos of people, and AI manipulates the movements of the mouth to fit new audio. A famous example of a lip-sync deep fake is the BuzzFeed News-produced video of Barack Obama

warning of the dangers that deep fakes and disinformation pose, with Jordan Peele serving as the voice actor. The most realistic type of fake videos are puppet-master videos, where a performer acts and says things that they want the target to appear to be doing. Then, using AI tools, the video is used to animate the target as having said and done what the performer did.

## National Security Risks

Deep fakes pose national security risks to both individuals and society as a whole in both foreign and domestic contexts. While fake images present risks, fake video and audio allow greater flexibility and therefore pose greater threats. Individuals targeted by deep fakes face reputational harm, loss of employment, and theft and identity fraud. They also may feel threatened and powerless to respond or disprove the fakes. At a society-wide level, deep fakes can be used to spread disinformation; inflame racial, ethnic, cultural, and political tensions; influence election outcomes; and destabilize the U.S. economy. Changing socio-political developments like COVID-19, nationwide racial justice protests, and national elections exacerbate existing political tensions, opening new avenues for disinformation tactics targeting the public.

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The American public first truly became aware of online influence operations and disinformation campaigns after the Russian government's "sweeping and systematic" interference in the 2016 U.S. presidential election, when Russian operatives hacked and disseminated a candidate's emails and spread fake news through social media accounts. The Intelligence Community has assessed that foreign actors continued their election interference schemes in the 2018 U.S. Congressional Elections and in the 2020 U.S. presidential election. And as the COVID-19 pandemic spread across the globe and within the U.S. in early 2020, intelligence officials watched Chinese operatives orchestrate mass texts to millions of Americans warning of an impending lockdown and martial law, showing the range of options in disinformation campaigns. The U.S. Intelligence Community currently considers efforts like these a top priority, listing them second in the 2019 Worldwide Threat Assessment. Deep fakes may exacerbate the problems associated with foreign electoral interference, as they provide unprecedented realism to false information.

## Deep Fake Photos

Deep fake photos pose significant national security risks for individuals including extortion, identity theft and fraud, and reputational harm. Additionally, they can be used to bolster other elements of a disinformation campaign, such as creating more realistic fake profiles and infiltrating social networks and organizations. These photos are likely to be created by foreign nation states, hacking groups, and aggrieved individuals depending on the purpose, context, and targets.

Individuals who hold positions of power within the U.S. government, private corporations, and large organizations may be blackmailed, extorted, or threatened with deep fake photos. A fake image of someone engaging in drug use or other questionable activities can be used to leverage information, money, or other things of value. According to a Congressional Research Service report, foreign intelligence operatives have already begun using deep fakes in social media profiles to recruit sources in the U.S.

Deep fake photos may also be used to improve the realism of other elements of disinformation and online influence operations. In 2019, researchers discovered a LinkedIn profile of a woman named Katie Jones who appeared to be deeply connected to many national security experts and other political figures in Washington. In fact, no such Katie Jones exists, and many elements of her profile indicate that she was likely created by a GAN. A scaly effect on her ear, mismatched and monochromatic eyes, a blurry earring, and the indistinct background made it clear that the photo was not real. However, the profile was still able to connect with more than 50 users on LinkedIn, including a deputy assistant secretary of state. Similar fake accounts are likely to be used to connect with influential members of government and business to siphon confidential information, create compromising situations, or to recruit them to directly work with foreign governments. While the Katie Jones profile was detected quickly due to the low quality of the image, more sophisticated efforts to fine-tune the generation algorithm can produce fake images that fool the naked eye.

## Deep Fake Video and Audio

Deep fake video and audio productions are more likely to pose serious national security risks at a society-wide level than photos due to the limitless possibilities of what can be created and shown. While the most serious threats are likely to be in the domestic context, such as those that target our elections and economy or try to spark hatred and division, serious threats could emerge from the spread of fake videos targeted at individuals

or in other countries. The technology used to create these videos has only gotten better, and it may now be used to interfere in deeper, more sinister ways against the U.S. and its citizens.

In more personal or intimate contexts, deep fake videos can be used to harass and intimidate individuals with blackmail or revenge porn. The first deep fake videos emerged in 2017 when internet users interposed the faces of celebrities between those of actors in pornographic videos. Since then, researchers have found that over 90% of deep fake videos are non-consensual porn, mainly targeting women. A report by the Cyber Civil Rights Initiative indicates that 90% of revenge porn victims are women, and that many have suffered reputational and emotional consequences as a result. Recent mobile and computer applications make it easy to create these videos: typically, just a few pictures from social media accounts are enough. Online communities have formed to share and request porn deep fakes of individuals and celebrities, which normalizes the behavior for would-be perpetrators. In one case, a mother of a high school cheerleader created deep fake videos and photos showing her daughter's rivals on the team naked while smoking and drinking to get them kicked off of the team. A concern regarding deep fakes videos being used in local or individual contexts is the difficulty of proving that they are fake. Without the resources that researchers and media organizations can bring to bear, individuals are susceptible to reputational harm, shame, and harassment. While instances like the one above do not pose significant national security threats to the U.S., they do create serious civil liberties and privacy concerns and are likely to be the majority of cases involving deep fakes.

***Deep fake videos provide unprecedented customization, targeting, and believability to hostile foreign actors working to spread disinformation.***

Deep fake videos can target politicians, business leaders, minority groups, activists, celebrities, members of our armed forces, or anyone else in a position of power or influence. Politicians could be displayed taking bribes or saying racist phrases, and the CEO of a company could be heard talking about a coming recession, triggering panic selling in the market. A video could circulate of police officers indiscriminately assaulting innocent civilians, causing riots across the nation before it can be disproven. According to Special Counsel Robert S. Mueller III in his 2019 *Report on the Investigation into Russian Interference in the 2016 Presidential Election*, a major element of the Russian social media campaign in

the months leading up to the election was to “provoke and amplify political and social discord in the United States.” Deep fake videos provide unprecedented customization, targeting, and believability to hostile foreign actors working to spread disinformation.

A video appearing to show House Speaker Nancy Pelosi slurring her words, almost as if she was drunk, spread rapidly on social media in 2019, even being tweeted by former President Trump with the caption, “PELOSI STAMMERS THROUGH NEWS CONFERENCE” (@realDonaldTrump, May 23, 2019). In truth, Pelosi had not slurred her words revise: words, and the video was not a deep fake. Instead, the perpetrators had simply boosted low frequencies in the audio, prompting House Intelligence Chairman Adam Schiff to refer to the effort as a “cheap fake.” The episode highlights the threat that deep fake videos pose to our political system and the rapid speed with which they can be seen and spread by millions of people. While news organizations were quick to debunk the video and social media companies worked to stymie its spread, new questions arose about what could be next. What if there were no “real” video to show alongside the fake? What if an accompanying video emerged a few days later showing that Speaker Pelosi had actually been drinking? This is the problem that deep fake videos and audio pose: they create narratives out of whole cloth, with little that can be done to fight them.

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Deep fake videos pose national security risks for the United States when they are spread in a foreign context. A video could be created and spread in another country to show U.S. military personnel engaged in war crimes or the murder of civilians, leading to increased radicalization, violence, and resentment against the U.S. These videos could spread widely before being detected, leaving populations vulnerable to unsuspected threats. Individuals in other countries may also possess lower levels of digital literacy, increasing the likelihood that deep fake videos will be believed. In late 2018 in Gabon, for instance, a video intended to reassure citizens of President Ali Bongo's good health was called a deep fake by his political opponents. They pointed out that his eyes seemed immobile and did not move in sync with his jaw. Outside experts following the controversy said that there was no way to know for sure if the video was a deep fake, but his opponents launched an unsuccessful coup as a result of their belief that it was. Similar tactics

could be used around the world to remove U.S.-friendly leaders or cause allies to reconsider their positions toward the U.S.

## Deep Fake Detection and Countermeasures

Government agencies, independent researchers, and private companies have created methods and tools able to detect hyper-realistic deep fake photos, video, and audio. The Defense Advanced Research Projects Agency has developed two programs to identify and combat manipulated media: MediFor (media forensics), which assesses the technical integrity of images or videos, and SemaFor (semantic forensics), which assesses semantic issues in manipulated media such as mismatched eye colors and earring placements. Both Google and Facebook have released data sets of deep fake and real videos in hopes of spurring independent innovation of detection methods. Content publishers like Facebook have also imposed greater restrictions in the effort to stop the spread of altered media like deep fakes. However, these restrictions are quite narrow and hard to apply due to their strict requirements about how the manipulated media was created and the intent of the poster, meaning they are likely to be ineffective in fully stopping the threat.

Many deep fakes are low quality and can be easily identified by semantic differences, image quality, and other oddities. In the Katie Jones LinkedIn profile, for example, researchers quickly identified artifacts that made the image look distorted and degraded. Common indicators of deep fake images and videos include skin being overly smooth or lacking details, scaliness or blurriness, flickering, odd head positions, face warping, and unnatural personal patterns of behavior including eye and lip movements.

***When these issues are present, it can be easy to debunk fake images and videos; when they are not, more technical solutions are required.***

When these issues are present, it can be easy to debunk fake images and videos; when they are not, more technical solutions are required. Many of these issues have already been solved in the latest GAN frameworks, and CNNs and GANs increasingly make it possible to preserve pose, facial expression and lighting in images and videos, meaning that detection methods will have to be constantly updated to compensate. Independent researchers have created several detection techniques of varying effectiveness and scope; however, more generalized and transferable solutions are still needed.

## Deep Fake Photo Detection

One of the most successful methods for detecting deep fake photos relies on artifacts left behind during the creation process. In 2019, Durall et al. used high frequency component analysis to detect artifacts hidden to the human eye indicating that an image may have been manipulated. The team's model achieved 100% accuracy identifying patterns of fakes during supervised learning tests—when a team member offered input and guidance—and 96% accuracy during unsupervised learning tests. Real and fake images have significantly different frequencies that allow them to be classified as either real or fake. While the model struggled to detect lower-resolution deep fakes, this is not a major issue, as these images are less convincing and have less potential to cause harm.

In 2020, Hsu, Zhuang, and Lee used pairwise learning and a common fake feature network to identify deep fake photos. The team's study proposed that by using pairs of images, one real and one fake, they could train their common fake feature network (CFFN) model to identify the most common features of deep fake images. Once the CFFN has been trained to identify the most common features, it can identify whether new images are deep fakes. This method works best on fake face detection, as many of the features across different faces are quite similar, unlike general objects in the world which vary in shape, size, color, and more. Hsu et al. noted that their CFFN may have trouble identifying deep fake images if new generators creating new fakes differ significantly from the generator used to train the CFFN.

## Deep Fake Video and Audio Detection

Several video detection methods can be applied to any deep fake video. In 2019, Korshunov and Marcel used two detection techniques to examine the susceptibility of facial recognition software to deep fake face swaps, with varying degrees of success. First, they found that facial recognition software failed up to 95% of the time on deep fake videos, meaning that the software identified the faces in the videos even though they were face-swapped. To combat this issue, they compared an audio-visual approach looking at lip-sync and mouth movements against an image quality technique. They found that the audio-visual approach was highly ineffective, as the deep fake videos accurately matched mouth movements with audio. On the other hand, the image quality technique, which measured signal to noise ratio, blurriness, and other signifiers, was able to identify deep fake videos with more than 90% accuracy.

A similar technique proposed by Güera and Delp uses a recurrent neural network with two components: a

CNN for frame feature extraction and a long short-term memory for temporal sequence analysis. Given an input video, the CNN obtains a set of features for each frame. Next, the features of a consecutive sequence of frames are combined and analyzed by the long short-term memory to produce a likelihood estimate for the probability of a video being a deep fake or not. Their method achieved accuracies greater than 97%, even using less than two seconds of video. This robust and generalized detection method and its ability to achieve high accuracies given low amounts of input will be important to consider in future detection research.

A more specifically tailored deep fake video detection method was proposed by Agarwal et al. to protect world leaders against deep fakes. They extracted data about the facial and head movements from hundreds of hours of footage of U.S. politicians including Barack Obama, Donald Trump, and Bernie Sanders. They found that the specific movements of each individual were quite different, meaning that they could be used to identify that individual. Agarwal et al. then trained a model on both real videos and deep fake videos of each of the leaders and found an average accuracy of 91% across the three main types of deep fake videos. However, their model's accuracy dropped to between 61%–66% for videos where the speaker was not facing the camera. Techniques like this reveal innovative ways that deep fakes can be detected, but it is unlikely that they can be generalized or used to combat deep fakes not targeting famous people.

## Implications

On April 26, 2020, the first deep fake targeting the 2020 U.S. election spread widely on Twitter and was retweeted by President Donald Trump. The deep fake, a gif of Vice President Joe Biden raising his eyebrows and rolling his tongue around, originated from a Twitter account called “@SiLERabbit” that mainly posted messages in favor of Bernie Sanders, who had dropped out of the Democratic Party's presidential primaries on April 8. While Trump had amplified edited media before, such as the Nancy Pelosi slurring video, this instance was different in that the content was completely fabricated. Journalist David Frum pointed out in *The Atlantic* that Trump's retweet “looks like an experimental test of the rules of social media.” It is not clear how the deep fake of Biden appeared in Trump's timeline or if it was sent to him by someone else, but it raises questions if the spread was orchestrated by foreign actors.

This incident may be a sign of a larger shift in how disinformation campaigns since the 2016 election postmortem are being carried out. While the Russian operation to interfere in the 2016 election succeeded in co-opting

and influencing news coverage and in engaging many American voters' attention, it failed in that the operation was detected and exposed in great detail. The Russians covered their tracks poorly, leaving behind online transactions, email accounts, correspondence, and other digital identifiers that allowed investigators to paint a detailed picture of the operation and to secure multiple indictments against the perpetrators. In the wake of this exposure, Russia and other foreign actors have sought to increase deniability and believability by outsourcing their operations. In 2019, the *New York Times* reported that “Rather than impersonating Americans as they did in 2016, Russian operatives are working to get Americans to repeat disinformation.”

***While the goals and content have remained constant, the tactics have changed, making it harder to track the origin of disinformation and the perpetrators behind it.***

Evidence of the shift in Russian tactics has emerged in Africa over the past year. In late October 2019, Facebook removed three networks of accounts that had been spreading disinformation in Mozambique, Cameroon, Sudan, and Libya. These accounts were linked to Yevgeny Prigozhin, who the U.S. indicted for meddling in the 2016 election. A 2020 CNN investigation found that Russian operatives linked to the Internet Research Agency have outsourced the actual running of accounts and posting to workers in nations like Ghana and Nigeria. These Russian-backed trolls have posted content targeted towards Americans to incite racial tensions and social unrest. While the goals and content have remained constant, the tactics have changed, making it harder to track the origin of disinformation and the perpetrators behind it.

While deep fakes today are usually easy to spot, they may not be in the future. Research into detection algorithms must at least match the development of creation algorithms. In turn, social media companies like Twitter and Facebook will need to employ these techniques at scale on their platforms. Major news organizations and other groups focused on fighting disinformation and providing transparency in technology will also need to adopt them.

The emergence of deep fakes presents many immediate challenges, but the broader issue is the continuing and deepening challenge to truth in our discourse. The U.S. is already incredibly divided by partisan rhetoric and media organizations that spread tensions across the political spectrum. Foreign actors further inflame these



tensions, leading to greater distrust in institutions and a lack of regard for the truth. Citron and Chesney refer to this deepening spiral as the "liar's dividend," in which citizens' growing awareness of deep fakes makes it increasingly easy to question the truth in any situation. As the public becomes more aware that deep fakes could be anywhere, they "may have difficulty believing what their eyes or ears are telling them—even when the information is real."

***It is unclear whether this new reality of disinformation, charged rhetoric, and increasing skepticism is a fleeting element of the moment or if it is here to stay.***

Americans have rarely vested full faith in their government, its institutions, and the media who report on both, but recent shifts in information and discourse have been rapid and startling. Accusations of "fake news," a term all but unheard of before 2016, are levied against all critical reporting by those who hold positions of power, no matter how valid. It is unclear whether this new reality of disinformation, charged rhetoric, and increased skepticism is a fleeting element of the moment or if it is here to stay, but deep fakes are certainly accelerating their influence on American discourse.

The fight for truth in American discourse faces a grim future. At the same time that foreign influence campaigns are becoming less expensive to operate and more successful in their reach and effect, the algorithms and programs used to create deep fakes are advancing much more rapidly than detection algorithms, regulations, laws, and societal demand for change. Russia may have invented the playbook in 2016 for successful online disinformation campaigns, but other nations and groups have been quick to adopt Russia's strategies. The Intelligence Community has already assessed that Iran and China have ramped up their election interference schemes, but disinformation does not stop at our elections.<sup>1</sup> Socio-political developments like the COVID-19 pandemic provide opportunities for malicious actors to spread disinformation and increase political tensions and polarization in the U.S. Deep fakes increase the potential damage of disinformation campaigns in too many imaginable ways, providing unprecedented believability to complete fabrications.



## Author's Note

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Nick Dunard ('21) graduated with a bachelor's degree in Intelligence Analysis with a minor in Political Science. As an undergraduate, Nick studied the intersections between national security, emerging technologies, and politics. He will continue his studies at the Catholic University of America in the Columbus School of Law and hopes to work as a lawyer in national security ethics and oversight.

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# Rachmaninoff's Second Piano Sonata, Op. 36

## Large Scale Narrative Consequences of Revision

Robert Carlson

### Abstract

A staple of the solo piano recital, Sergei Rachmaninoff's Second Piano Sonata, op. 36, stands as one of the final romantic submissions to the art of the piano sonata. Rachmaninoff first published the sonata in 1913, and he returned to the piece in 1931 to revise it substantially, removing about five minutes from its performance time. Despite its compositional, emotional, and physical virtuosity, the work has received little analytic attention regarding the relationship between the two versions. This paper investigates the consequences of Rachmaninoff's revisions by constructing a musical narrative for the sonata. The process illuminates structures within the piece that are central to its dramatic progression, and how revisions within certain sections can fundamentally transform the expressive relation between conflicting musical ideas.

Agony and ecstasy equally define Sergei Rachmaninoff's music. Transformational arcs of redemption can be found within his smallest preludes and titanic concerti, it is difficult to ignore an inherent narrative quality present in many of his works. Rachmaninoff's Second Piano Sonata, op. 36, encompasses this transcendental design. Though it may not be an emblem of modernism from its time, the sonata stands as a monument to the greatest heights of romanticism and the rich art of the piano sonata.

Originally published in 1913, Rachmaninoff's Second Piano Sonata, op. 36, was a part of his concert repertoire until he was forced to flee Russia in 1917 during the Bolshevik Revolution. In 1930, Rachmaninoff returned to the work to revise it, removing large chunks of material and reworking certain textural elements before republishing it the following year.<sup>1</sup> Despite its widespread popularity, Sonata op. 36 lacks significant analytical study. Most scholarship centers on the compositional differences between the two versions or the biographical circumstances under which the piece was written.<sup>2</sup> Scholars debate about which version of the sonata is the definitive version, and pianists often choose to incorporate passages from both versions into their performances.<sup>3</sup>

The intent of this study is not only to compare the two versions of the work, but also to raise questions about how revision can alter the experience or nature of a musical work. Considering the major discrepancies between the versions, an important question must be asked: how do the revision's temporal and sequential changes affect the sonata's overarching musical experience?

The goal in constructing a musical narrative to analyze Rachmaninoff's two versions of Sonata op. 36 is not to argue for any definitive interpretation of the sonata, nor to suggest that the narrative is in some way absolute. In the case of Sonata op. 36, Rachmaninoff did not leave any sort of indication that the work was to be understood within such a limited scope. As such, it would be a heinous offense to argue that the following narrative uncovers a program that comes from the composer himself. Why, one might ask, would narrative be a useful analytical tool for a work with no prescribed message?

<sup>1</sup> Sergei Rachmaninoff, *Piano Sonata No. 2, Op. 36, Original and Revised Editions, Complete*, edited by Peter Donohoe, (London, Boosey & Hawkes, 1993), 2.

<sup>2</sup> Renee MacKenzie, "Rachmaninoff's Piano Works and Diasporic Identity 1890-1945: Compositional Revision and Discourse," DMA diss, University of Western Ontario, 2018.

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Instead of condensing the artistic breadth and variety of this sonata into a single extramusical experience, this analysis aims to provide a generalized framework that could offer footholds for the listener or performer. Such a guide seeks to facilitate deeper musical understanding by providing an accessible context to the rhetorical structures and relationships within the piece.

The basis of the narrative is found in a church topic present within Sonata op. 36. This is not the only possible topic that could be selected to construct a narrative around the work; the context of the work's composition and Rachmaninoff's exile from Russia in 1917 could make for a very insightful perspective on the work.<sup>4</sup> The church topic was selected for its fairly simple interplay of dramatic elements: damnation versus redemption, pain versus healing, and so forth. These elements facilitate the construction of a musical narrative and consequently allow for Rachmaninoff's intricate work to be framed approachably. As the narrative unfolds, the manner in which its respective elements transform in temperament and quality inform the plot's development. The two most prominent figures of the church topic are the use of Russian Orthodox [church bells](#) and [chant](#).<sup>5</sup> The bells are defined by a ringing sonority: often, lower pitches provide a foundational tapestry over which higher pitches create a sound of sweet bursts and embellishments. Chant, on the other hand, is defined by a full-bodied, unified sound, with a generally limited range and often descending in melodic trajectory. The bells are typically used as a call to worship for services, and chant facilitates both prayer and praise.<sup>6</sup>

A bell gesture in Sonata op. 36 will be defined generally as a harmonic and motivic event marked by sonorous, ringing chords. As a motive, this gesture can be used as the seed of larger musical ideas to generate melodies and create relationships between musical sections, or be manipulated on its own to create drama. These gestures appear in both climactic and intimate moments and are often marked by either tenutos or accents that cause these notes to ring above an underlying sonority. Often, the bell texture is reinforced post-impact with a vibrating, metallic sound, depicting the manner in which large bells continue to buzz after being hit, as it sustains the pitch and the overtones become excited. This gesture can be found in abundance throughout the sonata, but many of its elements can be seen clearly in Figure 1. In Sonata op. 36, bells act as an iconic symbol

<sup>4</sup> MacKenzie, "Rachmaninoff's Piano Works and Diasporic Identity."

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Figure 1. Primary theme of the first movement, mm. 1-4.<sup>7</sup>

of the church signaling both a sort of conviction by a holy deity and an afflicted emotional state. Complementing these bell gestures are a few important passages that exemplify qualities of chant. The narrative proposed in this paper will be structured around the development of these bells and their transformation from a signifier of imminent damnation to one of redemption. Further discussion will consider how the prayerful, chant-like phrases interact with the work's expressive arc.

In the following analysis, I will construct a musical narrative of the original version of Sonata op. 36, highlighting key thematic, sequential, and tonal developments throughout the form. This narrative will supply us with a foundation to understand how revisions to the form may affect the work's underlying rhetorical structure. We will encounter a protagonist who begins at their lowest and is entrenched in shame, guilt, and agony. Throughout the course of the sonata, this individual is convicted by the church and continually seeks resolution from their ever-present affliction. In the third movement, they are revitalized by the resolution suggested by the church and pursue redemption. Faced with the same conflicts present at the beginning of the sonata, the protagonist struggles to come out victorious in battle, clawing their way to the finish line and finally earning a new life. Considering Rachmaninoff's revisions, we will see that the later version tells a different story. A reorganization in the use of the secondary theme from the first version's first movement invigorates the revision with a heightened energy that effectively redefines the theme as the true expressive impetus of the work.

The sonata immediately plunges into the depths of our protagonist's agony as they wrestle to understand and cope with a persistent torment. Here, we are presented with a fall from grace into the [primary thematic area](#) (P) with a violent act accompanied by three thunderous church bells.<sup>8</sup> P is defined by two elements: first, the initial impact of the B-flat in the bass that is complemented by the falling third gesture of F to D-flat in the top voice, and second, the descending melodic material in mm. 2-3, which outlines the tonic triad, B-flat minor, highlighting in particular the descent of F to D-flat. This thematic area is rife with conflict: our protagonist grows weak while wrestling with their consuming plight, ultimately retreating to a meditative state in search of solace.

The [second thematic area](#) (S) is the opposite of P, seen in Figure 2, offering a sense of peace and beauty. However, this prayer is composed of the same motivic material as P: a falling third emphasizing F and D-flat. With this prayer, our protagonist aspires to be relieved of shame and pain. However, an underlying tension begins to fester, and the protagonist is again confronted by [bells](#) that return them to their previous violent state. The development then begins in [mm. 66](#) with an exclusive focus on material from P. The canonic construction of the beginning of the development signals the obsession that plagues the mind of the protagonist as they ruminate over their troubles and the power of their looming conviction. In this huge wash of bells, the protagonist's shame and anxiety consume them entirely, hurling into the recapitulation in [m. 121](#). The grief and torment of P has become the forefront of the protagonist's existence.

<sup>7</sup> Sergei Rachmaninoff. *Piano Sonata No. 2, Op. 36*, Edited by Peter Donohoe, 4.

<sup>8</sup> Ashish Xiangyi Kumar, "Rachmaninoff: Piano Sonata No. 2, Op. 36 (Lugansky, Kocsis)," YouTube video, January 8th, 2017, [https://youtu.be/C\\_LOOYSz0Bc](https://youtu.be/C_LOOYSz0Bc).

Figure 2. Secondary theme of the first movement, mm. 37-38.<sup>9</sup>



Figure 3. Introduction to the second movement, mm. 1-7.<sup>10</sup>



Again, S arrives in [m. 140](#) and serves as a source of solace, at first seeming to suggest a solution. However, G-flat fails to offer structural resolution, as S does not appear in the expected key of B-flat minor or major. While both prayers in these keys grant our protagonist temporary peace, they have not yet resolved the core drama of the work, that being the minor mode of the primary key. The second prayer in G-flat major, like the first, gives way to a festering frustration which arrives on B-flat minor with bells in [mm. 159-168](#). The protagonist seems to return now to their original pained, agitated state with a sense of desperation. Following this final outburst, the movement slowly fades away with whisperings of guilt.

The second movement reaches out in search of solitude. Shown in Figure 3, the movement [begins](#) on an F-sharp dominant chord, which, understood enharmonically as G-flat, reaches back to the last moment of peace in the first movement. The protagonist is wandering about this dominant chord by third progressions that highlight a minor third relation between F-sharp and A, in search for resolution, before suddenly pausing on D major, which is a major third down from the initial F-sharp.

The starkness of this major third relationship is emboldened by the voicing of the D major chord: the F-sharp in the top voice reaches back to the beginning of the movement, clarifying the importance of the tonal relationship. Modulating to E minor, the protagonist mourns their present state, accompanied by a lamentive, descending bass line, beginning in [m. 8](#). Intervallically, E is the furthest possible note from B-flat (a tritone apart), and the protagonist has separated themselves as far from the guilt and shame previously experienced in B-flat minor. The melody is varied, in typical lament style, and the second movement's A section ultimately develops into a huge climax of bells in [mm. 28-35](#), shown in Figure 4.

Convicted again by these persistent bells, the protagonist is transported back to the P of the first movement, refocusing explicitly on their pain ([mm. 36-62](#)). Just as the protagonist's anxious obsession grows in the development of the first movement, thoughts overlap one another, becoming darkly chromatic and thematically complex. Variations of the first movement's P theme combat one another in a variety of augmentations, diminutions, and displacements before retreating to a brooding E minor ostinato on [m. 63](#). Here, the protagonist generates

<sup>9</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 7.

<sup>10</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 22.



Figure 4. Climax of the lament in the A section of the second movement, mm. 31-36.<sup>11</sup>

Figure 5. Second climax of bells in A minor in the second movement, mm. 67-73.<sup>12</sup>

the energy to confront the internal conflict again, contrasting greatly with mm. 36-62.

Yet again, the protagonist is confronted by the overwhelming clamor of bells, rising first from the bass in m. 63, as their confused, frustrated grief climbs to another climax. As seen in Figure 5, interjecting bell gestures alternate between multiple voices in each hand. In

the left hand, one voice is firmly set on the downbeats, and the other on the upbeats. The right hand contributes to this clamoring with accents on the downbeat with gestures derived from P of the first movement. These gestures outline E minor, which clashes with the A minor sonority asserted in the bass. Each of these elements unite to create a frenzied, chaotic terror—a breaking point for the protagonist. The final bell strikes,

<sup>11</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 24.

<sup>12</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 27.

plunging into the furthest depths of the keyboard before dissipating into thin air. In the wake of this sonic outburst, the protagonist is left without energy to obsess over the guilt and shame that each previous arrival of bells has initiated.

Now in E major, the protagonist slowly rises to a state of contemplation, returning with a new perspective on their previous lament in [m. 77](#). With the third arrival of a primary major key in this section (E major, preceded by D-flat major and G-flat major), the protagonist discovers the personal development required to achieve redemption: the transformation from minor to major. The distance of this key, however, is important: though the transformation is now known to the protagonist, it is a faint, distant, almost untouchable idea. In the [final breath](#) of the movement, shown in Figure 6, the motivic third appears within an inner voice and the bass, falling from B to G-sharp and G-sharp to E; a plan is made for a new life.

The third movement actualizes the self-transformation revealed in the second movement. [Beginning](#) with a similar introduction to the second movement, the third movement bursts forth in pursuit of redemption. In the first movement, S demonstrated how the major key symbolizes peace. The third movement is the final confrontation of the conflict presented by P, where the protagonist achieves redemption in the transformation from minor to major.

The primary thematic area of this movement ([P2](#)), shown in Figure 7, includes two distinct parts: a descending line of hammering bells (mm. 16-19) and an abridged variation of P (m. 20). The bells in P2 are in G-flat major, as they were in the second movement. This recalls the temporary resolution of G-flat in the recapitulation of the first movement. The bells now carry a new meaning, signaling understanding and a charge towards redemption. The secondary thematic area of this movement (S2) supports this resolution provided by the minor-major transformation, placing emphasis on G falling to E-flat throughout [mm. 91-125](#). Our protagonist is building strength, preparing to face a final test.

Though it seems that total resolution has been achieved, the protagonist is again confronted by adversity when the section begins with a direct juxtaposition of C major and C minor ([mm. 126-133](#)), shown in Figure 8. A wild fury ensues. Violent bursts of energy and various thematic ideas overlap one another. At first, it is not clear what will come of this; the bells even seem to resort back to their old meaning, shifting to minor keys: A minor, B-flat minor, and B minor. For the first time in the sonata, the protagonist reins in the chaos, rather than becoming exhausted by it. The conflict has not yet been resolved, however, and the music finds itself in E-flat minor ([m. 178](#)). Doubt enters the mind of the protagonist, as E-flat minor is closely related to B-flat minor. At first, it seems that what had been previously gained was lost, perverted by the minor mode. Simultaneously, an inner

Figure 6. End of the second movement, mm. 86-89.<sup>13</sup>



Figure 7. Primary theme of the third movement, mm. 12-20.<sup>14</sup>



<sup>13</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 29.

<sup>14</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 29.

Figure 8. Beginning of the development of the third movement, mm. 126-133.<sup>15</sup>



Figure 9. End of the development driving into the recapitulation in the third movement, mm. 193-204.<sup>16</sup>



voice ruminates on the structural tension between D-flat and D, rotating back and forth between E-flat, D, and D-flat.

This moment of doubt builds into a thundering climax, seen in Figure 9, taken from the beginning of the first movement—the protagonist is facing the final test for redemption. Rather unexpectedly, it does not arrive in B-flat major or minor, but D major in [m. 196](#). This section demonstrates the structural importance of D major and highlights the core component of the protagonist's transformation, the underlying motion of D-flat to D.<sup>5</sup> Finally, the bells of P2 arrive in B-flat major at the start of the recapitulation. At this moment, the protagonist has achieved redemption and B-flat major has become the prevailing mode.

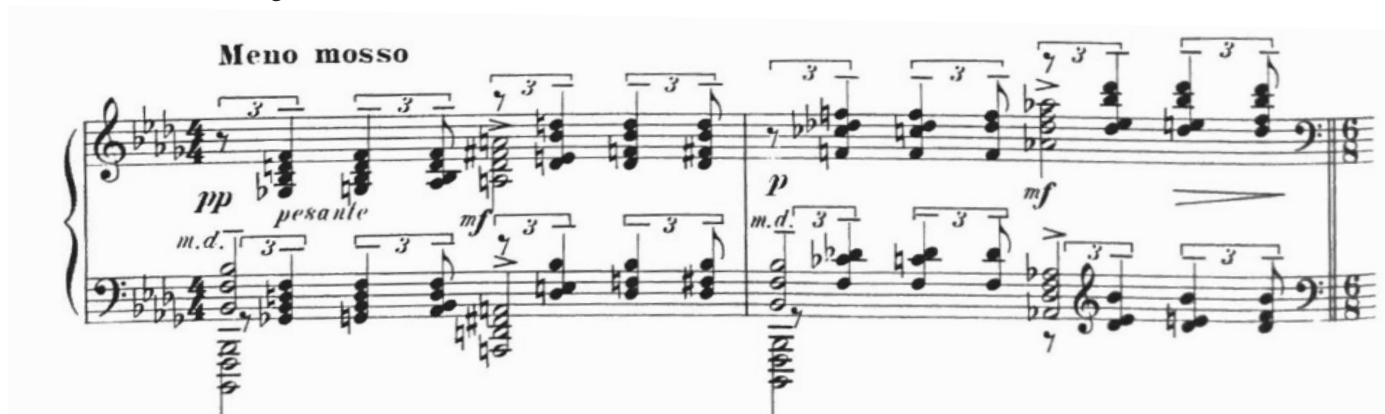
The formal pace of the recapitulation accelerates as excitement builds, shortening the return of P2 and driving through transitional material. The arrival of S2 ([m. 240](#)) in B-flat major confirms the resolution achieved in the third movement, placing a strong emphasis on D major. This resolution drives into the [coda](#), which celebrates a newfound liberty, building towards a final explosive declaration of joy.

To summarize, our narrative follows a protagonist violently stricken with grief and tragedy in the first movement. They desperately search for solutions and relief, but to no avail; even their prayers in S and an encounter with ethereal, sublime beauty cannot cure the hardship.

<sup>15</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 36.

<sup>16</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 39-40.

Figure 10. The transition into the coda, revised edition, mm. 123-124.<sup>17</sup>



Each time they succumb to the same agitated, troubled state of mind. Frustrated and tired, the protagonist mourns their dismal state in the second movement, trying again in vain to confront this persistent calamity. Broken and dejected, the protagonist suddenly finds themselves in an unlikely place.

This is showcased through a key that makes it appear that the protagonist is far away from home where they become contemplative and discover a possible solution in the major mode. However, the battle is not yet won. In the final movement, the protagonist jumps back into the fight with a newfound energy. Here, they face many trials. Suspense grows as they nearly fall back into the same state as they were in during the first movement. It is not until the very end of the work that the conflict is resolved and a thunderous celebration ensues.

With this narrative constructed, it is now possible to consider the consequences some of the major structural revisions have on the musical experience of the work. The general trajectory of the narrative is consistent between both versions: a protagonist wrestles with conviction and eventually achieves redemption. Many of Rachmaninoff's 1931 edits were simply simply textural, and it is not within the scope of this study to examine the consequences of every individual revision. However, in each movement, Rachmaninoff made a few substantial changes large enough to have a significant impact on the functioning elements of this narrative.

The most significant changes in the first movement are the transitions out of S. In the original recapitulation, as the protagonist finishes their second prayer, they seem to fall into another violent outburst. It is an act of desperation that grasps for some sort of exoneration. In the revision, however, Rachmaninoff altered the transi-

tion greatly, suggesting a tempered, introspective character.

The transition [winds down slowly](#), arriving at a statement of bells, but this time quietly, as shown in Figure 10.<sup>18</sup> These redacted transitions out of S have a significant impact on the development of the narrative in the first movement. Previously, the protagonist exits their contemplative, prayerful state to mourn their pain and express their unhappiness. In the revision, the protagonist never leaves this state. Here, the arrival of the bells signifies an internalization by the protagonist: they no longer fight against the conviction. In this prayer, the protagonist ruminates what must be done to receive liberation. In the first measure of Figure 10, a B-flat major chord is directly opposed to a D major chord, which is followed by its darker alternative, as a B-flat major chord is opposed by D-flat major. This implicates the core tonal conflict of the sonata (major vs. minor), and inverts the eventual transformation of D-flat to D (minor to major) in the third movement. Also, in this passage, the closely knit attachment between B-flat major and D major, alternatively B-flat minor and D-flat major, is demonstrated. These tonal pairings play an important role later in the third movement, which is a key moment of foreshadowing. Furthermore, the revision subtly modifies the function of the prayer in the sonata, setting a precedent that Rachmaninoff developed in the second movement's revisions.

In the second movement, Rachmaninoff replaced the return of the A section's lament with a [quotation](#) of S from the first movement in E major.<sup>19</sup> This revision does not

<sup>17</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 58.

<sup>18</sup> Robert Carlson, "Sonata No. 2, Op. 36 (1931) I. Allegro agitato - S. Rachmaninov," YouTube video, November 11, 2019, <https://youtu.be/4EpgF18yQoU>.

<sup>19</sup> Robert Carlson, "Sonata No. 2, Op. 36 (1931) II. Lento - III. Allegro Molto - S. Rachmaninov," YouTube video, November 11th, 2019, [https://youtu.be/T2-L\\_hfzHWg](https://youtu.be/T2-L_hfzHWg).

break from the aesthetic of the section, for the church topic is still clearly present, but it does change the narrative structure of the work. Rachmaninoff had already used cyclicism in his original version in the development of P and the motivic relationships between each movement. S did not receive this same treatment in the original. It is related to P due to its motivic make-up, and by that association it possesses a tangential relationship to the later movements. However, by inserting a direct quotation of S into the second movement, which interrupts the expected rotation of events, Rachmaninoff alters the inherent tension between P and S.

In the original version, shown in Figure 11, S offered temporary solace, or even suggested a solution to the protagonist's problems when it appeared. Each time, it proved to be useless. In the revised version, S acquires a progressive impact. Considering the revision in the first movement, each arrival of this theme creates some sort of change in the protagonist. The first arrival of S affords temporary solace, yet it ultimately degrades in light of their painful ordeal and multiplies into a roaring climax in the development. Returning to S at the end of the first movement, the protagonist remains in this contemplative, unsatisfied state and seems quietly tortured. With its third statement in the second movement, S enacts a solution where peace is found, and the protagonist has been changed. This revision greatly

enhances the drama of the E major tonality, as the protagonist discovers that they had the answer before them from the very beginning. S then rises to a new rhetorical level effectively, becoming quite competitive with P. One might argue that this competition occurs in the original version in a very obscure manner through its use of major keys. While plausible, the refined function of S and cyclicism in the revision engrained this expressive action on a dramatic, thematic, and formal level, bringing it prominently to the surface.

The revisions of the third movement are the most extensive. In the development section, Rachmaninoff not only altered most of the textural elements, but deleted half of the development section, [mm. 166-199](#), from the original.<sup>22</sup> This omission has a major impact on the narrative flow of the movement. It removes the suspense created by the protagonist's struggle, allowing them to come out victorious in the final battle for redemption with the appearance of material from the first movement in E-flat minor. In the revision, there is no transition between the original [m. 165](#) and [m. 200](#), such that the B-flat major bells [arrive, suddenly](#), asserting full dominance.<sup>23</sup> Previously, the third movement continued to create suspense and doubt about the ultimate outcome of the protagonist's struggle until the very end. As shown in Figure 12, the revision almost entirely removes this doubt.

Figure 11. Cyclical statement of S in the second movement, revised edition, mm. 65-67.<sup>20</sup>



Figure 12. Direct transition out of development, revised edition, mm. 142-149.<sup>21</sup>



<sup>20</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 65.

<sup>21</sup> Rachmaninoff, *Piano Sonata No. 2, Op. 36*, edited by Donohoe, 73

<sup>22</sup> Kumar, "Rachmaninoff: Piano Sonata No. 2, Op. 36."

<sup>23</sup> Robert Carlson, "Sonata No. 2, Op. 36 (1931) II. Lento - III. Allegro Molto - S. Rachmaninov," YouTube video, November 11, 2019, [https://youtu.be/T2-l\\_hfzHWg](https://youtu.be/T2-l_hfzHWg).

If the development of the third movement in the original creates suspense and doubt, then its omission in the revised version effectively removes this dramatic element from the narrative. In turn, the protagonist becomes powerful, mighty, and celebratory. In the revision, the protagonist has effectively achieved redemption at the end of the second movement, and the third movement simply celebrates.

As mentioned at the beginning of this paper, the aim in analyzing the different narrative shapes available in Rachmaninoff's two versions of Sonata op. 36 is not to suggest a definitive narrative present in the sonata. Instead, this narrative analysis aims to provide a template on which we may consider the work and initiate a dialogue about the consequences of substantial revision. Future research in this topic would require an extensive analysis of the subjective act of narration in the sonata as it relates to the protagonist. Additionally, a more nuanced study of the topical elements in the sonata could greatly enhance a narrative understanding of this work.



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Robert extends his gratitude to Dr. Jonathan Gibson for his guidance in the creation of this study, and to the *JMURJ* Editorial Board for their assistance and patience in the process of refining this paper.

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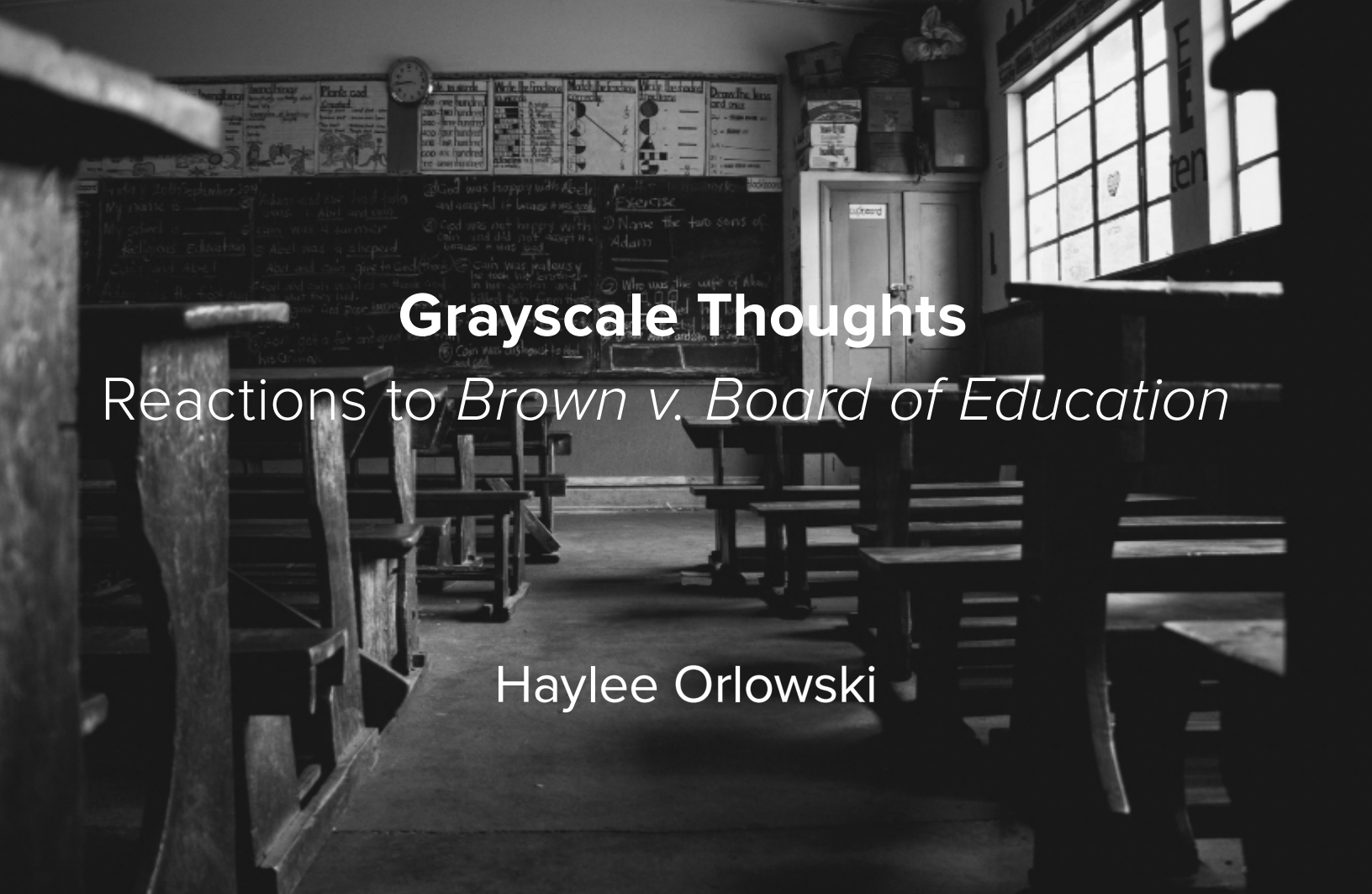
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# Grayscale Thoughts

## Reactions to *Brown v. Board of Education*

Haylee Orlowski

Photo by Mwesigwa Joel on Unsplash.

### Abstract

The 1954 Supreme Court case *Brown v. Board of Education* established that the segregation of public schools based on race violated the Equal Protection Clause of the Fourteenth Amendment. Across the United States, there was a spectrum of reactions to *Brown*. Responses ranged from optimism and celebration to anger and violence. This paper surveys the varied reception of *Brown* from politicians, parents, teachers, journalists, and other parties. It acknowledges the grayscale of opinions within and across demographic lines. The purpose of this paper is to recognize the complexity of a critical moment in the civil rights movement to prevent the oversimplification of American history.

The landmark 1954 Supreme Court case *Brown v. Board of Education* did not simply reverse the precedent of “separate but equal” concerning school segregation; it turned the infrastructure of society on its head. The *Brown* decision was a civil rights triumph, but implementation created political tension and dissent across the nation. School desegregation efforts that followed in the first years after the decision were met with aggressive resistance from Southern states. Officials demonstrated their disdain for the federal order through both public political defiance and personal statements. With no clear plan or support from the federal government in its formative years, *Brown* led to uncertainty and strong initial reactions from individuals.

***The Brown decision was a civil rights triumph, but implementation created political tension and dissent across the nation.***

Often oversimplified into camps of “for” or “against” along racial divides, reactions to the *Brown* decision were more complex. Feelings varied on the individual level, with both African American and white individuals abandoning the dominant sentiments of their demographic in regard to *Brown* and school integration. This paper surveys contemporary newspaper editorials, opinion pieces, letters, and articles, along with more recent scholarship and reflections, to represent the broad range of responses that *Brown* elicited. Evaluating *Brown* from multiple perspectives prevents the oversimplification of American history.<sup>1</sup>

**“Separate but Equal”**

In response to the Reconstruction era after the Civil War, Southerners sought to create an infrastructure

that suppressed the rights of African Americans in their region. The statutes and de facto racism set in place during this period only continued to expand over the course of the early twentieth century, particularly after the Supreme Court case *Plessy v. Ferguson* (1896) ruled that “separate but equal” was constitutional. As a result, segregation and Jim Crow laws permeated Southern American culture. The government approved of separating Americans based on their skin color, as long as each group was provided “equal” access to spaces and resources. This “separate but equal” decision enabled racism and segregation without constraint, from separate drinking fountains and local transportation to public schools and movie theaters.<sup>2</sup>

Following the end of World War II in 1945, African Americans began to call more adamantly for their rights and equal treatment by their state and federal governments. African American soldiers came home from serving on the front lines of the global war and, alongside civilians, expressed their aversion to the mistreatment they experienced in their hometowns. Vocalization against a discriminatory system so deep-rooted in the hearts of many white Southerners created incredibly contentious environments within Southern states. This tension between the two largest groups in the region led to both civil and violent conflicts as African Americans fought to be treated as equal to their white neighbors.<sup>3</sup>

***Through court cases in Delaware, Kansas, South Carolina, Virginia, and Washington, DC, during the 1940s and early 1950s, the NAACP fought for equality within segregated higher education.***

African American activist organizations, such as the National Association for the Advancement of Colored People (NAACP), and various grassroots groups worked to counter racism on both state and national levels through the judicial system. One of the most evident forms of mistreatment and disadvantage was the inequality of public schools. Through court cases in Delaware, Kansas, South Carolina, Virginia, and Washington, DC, during the 1940s and early 1950s, the NAACP fought for equality within segregated higher education, such as law schools. Though the specifics of these “equalization suits” varied—some aimed for full integration of African American and white students (Delaware), while others aimed to secure better African American schools which were equal in resources

<sup>1</sup> For a good overview of the civil rights movement, see Frederic O. Sargent, *The Civil Rights Revolution: Events and Leaders, 1955-1968* (Jefferson, NC: McFarland, 2004), and Michael Ezra and Peter C. Mancall, *Civil Rights Movement: People and Perspectives* (Santa Barbara, CA: ABC-CLIO, 2009). To read more on the court case *Brown v. Board of Education*, consult Diane Telgen, *Defining Moments: Brown v. Board of Education* (Detroit, MI: Omnigraphics, 2005); J. Harvie Wilkinson III, *From “Brown” to “Bakke”: The Supreme Court and School Integration, 1954-1978* (New York: Oxford University Press, 1979); Lynn W. Zimmerman, “Reflections on *Brown*,” *American Educational History Journal* 33, no. 2 (2006): 89-96, Education Research Complete; Raphael Cassimere Jr., “Remembering *Brown v. Board of Education*,” *The Crisis* 101, no. 4 (1994): 10, 17-18, Education Research Complete; and Richard Kluger, *Simple Justice: The History of “Brown v. Board of Education” and Black America’s Struggle for Equality* (New York: Alfred A. Knopf, 1976). For further information on Massive Resistance, refer to Francis M. Wilhoit, *The Politics of Massive Resistance* (New York: George Braziller Inc., 1973) and Numan V. Bartley, *The Rise of Massive Resistance: Race and Politics in the South During the 1950’s* (Baton Rouge: Louisiana State University Press, 1969). For additional readings on Southern responses to this decision, see R. Ray McCain, “Reactions to the United States Supreme Court Segregation Decision of 1954,” *The Georgia Historical Quarterly* 52, no. 4 (1968): 371-87, [www.jstor.org/stable/40578897](http://www.jstor.org/stable/40578897); James J. Kilpatrick, *The Southern Case for School Segregation* (New York: Crowell-Collier Press, 1962); and Angie Maxwell, *The Indicted South: Public Criticism, Southern Inferiority, and the Politics of Whiteness* (Chapel Hill: The University of North Carolina Press, 2014). Finally, for a better understanding of contemporary sentiments regarding the case and its decision, refer to “Text of 96 Congressmen’s Declaration on Integration,” *New York Times*, March 12, 1956, Proquest, and *Brown v. Board of Education*, 347 U.S. 483 (1954), for the primary legal material of the case and decision.

<sup>2</sup> Waldo E. Martin Jr., *“Brown v. Board of Education”: A Brief History with Documents* (Boston: Bedford/St. Martin’s, 1998), 76-80.

<sup>3</sup> Kluger, *Simple Justice*, 224-227.



and facilities to white schools (Virginia and South Carolina)—all five cases sought school equality. Each case was unsuccessful in the lower courts, and was appealed to the U.S. Supreme Court. Since these cases did not achieve the change African American activist groups wanted, Baltimore lawyer Thurgood Marshall compiled extensive evidence from each case to fight segregation in public education. Marshall, the NAACP's chief lawyer since 1938, had detailed where to bring up the initial suits, what schools should be desegregated, and who to file each suit against so that the case would be its strongest when addressed by the federal judiciary.<sup>4</sup>

## Legal Integration

*Brown v. Board of Education* first reached the Supreme Court in 1952, only two years after Marshall convinced the NAACP to challenge institutional segregation in public education. The *Brown* case brought a compilation of the five different cases about school segregation before the Supreme Court. All five cases shared the same argument: the “separate but equal” doctrine in *Plessy v. Ferguson* violated the Equal Protection Clause of the Fourteenth Amendment. Initially, the case was sent back and forth between the state courts and Supreme Court, which made acquiring a court hearing a lengthy process. After much deliberation, the Supreme Court decided on June 9, 1952, that it would hear the five school segregation cases. The Court combined the cases into one trial set to begin in October 1952, which was later postponed to December to be heard with other school cases.<sup>5</sup>

***All five cases shared the same argument: the “separate but equal” doctrine in Plessy v. Ferguson violated the Equal Protection Clause of the Fourteenth Amendment.***

The case was delivered with two distinct sides: pro-integration on the part of Thurgood Marshall and the NAACP versus anti-integration on the part of South Carolinian attorney John Davis. Marshall and the NAACP accused “separate but equal” of violating individual rights based on the Fourteenth Amendment, while Davis claimed schools separated by race served the needs of ill-educated African Americans and that the social experiment of integration would disadvantage these students rather than benefit them. After the *Brown* case hearing ended, the Supreme Court Justices deliberated throughout 1953. Newly appointed Chief

Justice Earl Warren advanced his strong convictions in the deliberations that “separate but equal” created de jure inferiority of African Americans and was therefore unconstitutional.<sup>6</sup>

Following many conferences regarding the case, the Supreme Court released their decision on May 17, 1954. Warren delivered the unanimous opinion. The opinion was brief given the complexity and significance of the case. Warren highlighted the importance of education to the development of every individual, and the nation holistically, by providing equal opportunity. He argued “to separate them [African American students] from others of similar age and qualifications solely because of their race generates a feeling of inferiority.”<sup>7</sup> The Supreme Court called for the disbanding of the “separate but equal” doctrine in public education due to its violation of the Fourteenth Amendment’s Equal Protection Clause. Desegregation was to begin in all state public education systems. Implementing this decision would fundamentally alter the infrastructure of school systems in over half of the United States, including the District of Columbia.

## Initial Optimism

The implementation of *Brown* was seen as the beginning of movement toward equal rights for all citizens. African American newspapers emphasized the popular sentiments of enthusiasm and hope in the weeks following the Court’s decision. In the *Pittsburgh Courier*, editorialist George S. Schuyler wrote, “The whole atmosphere for acceptance of such a decision as the Supreme Court handed down the other day was slowly being created in the Jim-Crow areas. If it hadn’t existed, the Court would not have rendered the decision it did.”<sup>8</sup> Schuyler had been criticized for voicing this belief prior to the *Brown* decision but was still not surprised by the outcome. Other national leaders were quoted in the same May 29 issue of the *Courier* with positive views regarding *Brown*. The National Association of Colored Women (NACW) president, Irene McCoy Haines, declared the decision to be “the greatest judicial finding in favor of the welfare of the Negro groups since the passage of the Thirteenth, Fourteenth, and Fifteenth Amendments.”<sup>9</sup> Hopeful and confident testimonies, such as these, were abundant in African American newspapers.

<sup>6</sup> Kluger, *Simple Justice*, 541; Juan Williams, “Thurgood Marshall and *Brown v. Board of Ed.*,” *Morning Edition*, National Public Radio, December 8, 2003, <https://www.npr.org/2003/12/08/thurgood-marshall-and-brown-v-board-of-ed>; Patterson, “*Brown v. Board of Education*,” 64.

<sup>7</sup> *Brown v. Board of Education*, 347 U.S. 483, 494 (1954).

<sup>8</sup> George S. Schuyler, “High Court Decision Was No Surprise to Him,” opinion, *Pittsburgh Courier*, May 29, 1954.

<sup>9</sup> “Nat’l Leaders Laud Ban on School Segregation: Supreme Court’s Decision Called ‘Long Over Due,’” *Pittsburgh Courier*, May 29, 1954.

<sup>4</sup> Wilkinson III, *From “Brown” to “Bakke,”* 27.

<sup>5</sup> James T. Patterson, “*Brown v. Board of Education*: A Civil Rights Milestone and Its Troubled Legacy” (New York: Oxford University Press, 2001), 21, 27; Kluger, *Simple Justice*, 540.

They articulated the popular opinion amongst the community, while also working to convince those who were wary about *Brown's* impact on the nation.

Thurgood Marshall enforced these hopeful sentiments. When asked about *Brown* after his legal victory, Marshall often expressed how implementation was inevitable and would likely be swift, no matter the region. One October article from *The Washington Post and Times Herald* best displays Marshall's optimism about the future of school integration: "If they can desegregate schools in Baltimore, they can desegregate schools anywhere, including Biloxi, [Mississippi]."<sup>10</sup>

A month later in the same newspaper, Marshall responded to news that Southern states were moving to establish private schools: "I don't believe people would be able to abolish school systems they have spent 70 or 80 years building up."<sup>11</sup> Marshall was certain these Southern threats to establish private schools were empty and believed that people would not go through unnecessary trouble to evade the inevitability of integration. Marshall's initial confidence in public school integration's success was unwavering, but he did not realize the defiance *Brown* would face in the coming years.

### ***The NAACP realized that legal success did not translate to triumph over the larger issue of racism that plagued American society.***

The initial elation expressed by Marshall, the NAACP, and African American newspapers waned as they evaluated the logistics of this legal decision. In the first month following the *Brown* decision, the NAACP realized that legal success did not translate to triumph over the larger issue of racism that plagued American society. The June-July issue of their magazine, *The Crisis*, was dedicated almost entirely to *Brown* and expressed this awareness. In the editorial section of the issue, one author wrote, "We also feel it necessary to temper our exultation with the warning that this is a major battle won, not a campaign concluded." They added that having "unintelligent optimism and childish faith in a court decision can blind us to the fact that legal abolition of segregation is not the final solution for the social cancer of racism."<sup>12</sup> This editorial communicated the NAACP's optimism, but also acknowledged the fight

for equality being far from over. They recognized the opposition from Southerners who believed their state rights and cultural customs were threatened by *Brown*, but nonetheless planned to continue their pursuit of school integration across the United States.

## **Compliance with Integration**

Many states believed in the inevitability of this court decision and agreed to implement integration as outlined in *Brown*. As Missouri State Attorney General John Montgomery Dalton put forth in a ten-page statement a month after the *Brown* decision: "It is the opinion of this office that the provisions of the Missouri Constitution and Statutes relating to separate schools 'for white children and colored children' are superseded by the decision of the Supreme Court of the United States and are, therefore, unenforceable." With this statement, Dalton confirmed the plan of Missouri, a border state, to move forward with integration, a position that contrasted from the Deep South.<sup>13</sup>

Accordingly, the majority of communities in Missouri planned to integrate their schools by September 1955. The reason for this pro-integration stance was because state officials saw benefits in the desegregation ruling. Funding the dual education system was a financial burden on the state and abolishing the system would considerably relieve the state budget. The closing of segregated schools was not perfect though. As part of the cost savings, Missouri reduced the number of teaching positions throughout the state. In Moberly, Missouri, fifteen teaching contracts were not renewed, with eleven African Americans denied their positions. This case displayed how inequality was a deeper-rooted and more widespread issue in America than the general population was led to believe.<sup>14</sup>

Despite common anti-integration sentiments, some Southern and border state officials admitted to the decision's inevitability and spoke in favor of gradual implementation beginning at the local level. One such person was distinguished Richmond attorney and Pulitzer Prize winner, David John Mays, who detailed in his personal diary: "I am satisfied of the following: (1) integration is certain to come; (2) Virginia people will sacrifice their public school system, even today, to prevent integration; and (3) ultimately we must cushion the impact of integration at the local level, although under general statutes." Mays's concession showed how

<sup>10</sup> "NAACP Encouraged, Virginians Are Told," *Washington Post and Times Herald* (1954-1959), October 12, 1954, Proquest.

<sup>11</sup> "Integration Foes Seen Facing Suit," *Washington Post and Times Herald* (1954-1959), November 29, 1954, Proquest.

<sup>12</sup> "Segregation Decision," editorial, *The Crisis*, June-July 1954, 352, [https://books.google.com/books?id=9VcEAAAAMBAJ&printsec=frontcover&source=gbs\\_ge\\_summary\\_r&cad=0#v=onepage&q&f=false](https://books.google.com/books?id=9VcEAAAAMBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false).

<sup>13</sup> Peter William Moran, "Border State Ebb and Flow: School Desegregation in Missouri, 1954-1999," in *With All Deliberate Speed: Implementing "Brown v. Board of Education"*, eds. Brian J. Daugherty and Charles C Bolton (Fayetteville, University of Arkansas Press), 179, <https://doi.org/10.2307/j.ctt1ffjdp.12>.

<sup>14</sup> Moran, "Border State Ebb and Flow," 180.

not all white Southerners were aggressively fighting for segregation.<sup>15</sup>

Intellectuals, newspaper editors, and ordinary citizens also voiced their views. One writer and social critic, Lillian Smith of Georgia, wrote to *The New York Times*: “Then why are a few politicians protesting so angrily? Perhaps because they feel they will now be handicapped if the old crutch of ‘race’ is snatched away from them.”<sup>16</sup> She expressed the resentment small pockets of Southerners felt toward those who wanted to defy the federal government and perpetrate racism for their own agendas. Even individuals who would later oppose integration, such as *Richmond News Leader* editor James J. Kilpatrick, initially spoke of the Court’s decision neutrally. Kilpatrick wrote in an editorial: “To bring the two races together in the social intimacy of a classroom will not come easily to the South. ... However, if the court would consent to a more moderate program of integration, the prospect of preserving public education in the South would be immeasurably improved.” He spoke on the importance of preserving public education in Virginia and explained how the *Brown* decision should not cause a system of “tutors and private schools for the well-to-do, and illiteracy for everyone else.”<sup>17</sup> These statements echoed the feelings of other white conservatives, who believed change should happen eventually, but not in the form presented by the Court.

Amongst the reactions of white Southerners, many of Virginia’s political and educational leaders were more concerned about *Brown*’s long-term impact than the often-described “immediate” anger. Bitterness was one popular sentiment, as many believed the Supreme Court infringed on the conventions of the South. College students at the University of Virginia claimed this bitterness was justified; an excerpt from a 1954 editorial in the University of Virginia *Cavalier Daily* read, “It is hard from a strict legal point of view to justify any action contrary to law,” displaying wariness and annoyance more than an outright defiance of *Brown*.<sup>18</sup> Additionally, some Virginia government officials voiced a variety of responses to the Supreme Court’s ruling. State Superintendent of Public Instruction Dowell J. Howard and State Attorney General J. Lindsay Almond Jr. both expressed their apprehension regarding the decision and its implementation, but also expressed their belief that Virginia would be compliant with the new federal

standard. As Almond Jr. stated, “The highest court in the land has spoken and I trust that Virginia will approach the question realistically and endeavor to work out some rational adjustment.”<sup>19</sup>

## Parents and Teachers’ Unease

Though African Americans acknowledged the good intentions of the *Brown* decision, many teachers and parents were unsure whether the Supreme Court was introducing the right course of action when it came to African Americans attaining equal rights. The equalization suits which preceded *Brown* aimed to protect and improve the resources and facilities already available to African American students and teachers. These cases intended to find a middle ground of progress which was palatable to a larger portion of the public. Since the outcomes of these cases hardly succeeded in the ways those who filed had hoped for—the results they sought either succeeded with partial equality or were wholly denied by the courts—*Brown* aimed to overhaul this separated system. *Brown* called for no equalization of different school systems, but for the integration of students into unified school systems. *Brown* introduced a new hope for progress, but it failed to consider the inequalities integration could create for African American students and teachers. Overturning America’s deep-rooted cultural and social racism would take more effort than one legal victory could achieve.

***Overturning America’s deep-rooted cultural and social racism would take more effort than one legal victory could achieve.***

In Prince Edward County, Virginia, African American parents watched legislators withhold funds for public schools while elitist white-only private schools were established to prevent integration. In the state of Florida, African Americans could not see the reality of *Brown*’s proposed “fixes” for equal rights. Some wanted to focus on equalization, or the equal distribution of resources between African American and white schools, which was already occurring in some Southern states, rather than uproot an entire infrastructure the population knew and accepted. As Judge Constance Baker Motley recounted, “They [the NAACP] brought a number of cases seeking to equalize the salaries of Black teachers. They also brought cases which were directed at the graduate school level because no separate facility had been provided for Blacks at that level.” Motley explained

<sup>15</sup> David John Mays, *Race, Reason, and Massive Resistance: The Diary of David J. Mays, 1954-1959*, ed. James R. Sweeney (Athens: University of Georgia Press, 2008), 36.

<sup>16</sup> Lillian Smith, “Ruling on Schools Hailed,” letter to the editor, *New York Times*, May 31, 1954, Proquest.

<sup>17</sup> James J. Kilpatrick, “The Decision,” editorial, *Richmond News Leader*, May 18, 1954.

<sup>18</sup> “Violates’ Way of Life,” *Cavalier Daily*, May 18, 1954, quoted in Martin Jr., “*Brown v. Board of Education*,” 206-207.

<sup>19</sup> Quoted in Benjamin Muse, *Virginia’s Massive Resistance* (Bloomington: Indiana University Press, 1961), 5.

how the NAACP expected resistance, but nowhere near the sophisticated or extensive lengths actually taken by the opposition.<sup>20</sup>

Parents worried about the safety of their children and advocated for maintaining segregation. Thus far, their children had associated with those who were like them, which was not the case when school integration started. Additionally, some argued that maintaining segregated public schools would keep violent and cruel resistance efforts at bay. As *The Chicago Defender* noted in a 1957 article, “[The] Negro proportion of school enrollment in Southern and border states has declined in ten states and increased in seven states and the District of Columbia in five years since the original school segregation cases went to the U.S. Supreme Court.” Parents’ caution with the system of integration and its dangers led to large groups of African Americans fleeing to the North, where they believed they would experience less hostility and condemnation that many Southern whites harbored during this time period.<sup>21</sup>

Parents opted to send their children to other school districts when their local schools closed. As one Prince Edward County father, Phillip Ward, explained to his daughter, “the whites don’t want Black kids to be with their kids. They feel you’re below them.”<sup>22</sup> Ward’s words conveyed the reality many Southern African Americans faced, a reality that had been their worry since the *Brown* decision. Though parents were defeated and unhappy about the lack of substantial enforcement for school integration, they were nonetheless determined to see their children receive a proper education.

The dangers of integration African American parents worried about were not always as civil as school closures; one event demonstrated that violence was a real threat facing African Americans seeking to integrate. In 1958, Clinton High School in Clinton, Tennessee, was bombed with dynamite after the state of Tennessee implemented integration on a local option basis. Integration in Clinton first occurred during the 1956-1957 school year. By the second day of classes, there were already threats of violence. The National Guard was called to keep the peace for the following two weeks. This temporary alleviation did not cease acts of violence and intimidation; shots were fired, and dynamite was thrown into Afri-

can American communities. The principal of Clinton High School even faced bomb threats by angry white townspeople. This tension over integration came to a breaking point when the school was bombed one night in October, 1958. Three separate explosions obliterated the interior of the school, causing damage which led the local newspaper publisher to predict that “it would be quite a while before classes can be resumed at the school.”<sup>23</sup> A statement released by Clinton Police Chief Francis Moore explained how there was “no doubt that this dynamiting is connected with integration of the school.”<sup>24</sup> Despite two years of integration, white Southerners still performed extreme measures to express their opposition. Clinton High School’s bombing, and other instances that paralleled it, made national news and further heightened the worries of African American parents.

***Many African American teachers were dismissed from their jobs because white teachers were given priority in the integrated school market.***

African American teachers also experienced anxiety in light of their diminishing job opportunities as a result of *Brown*. When schools were segregated, African American teachers regularly had the ability to teach at the schools of their own race, since the teaching profession was segregated for teachers as much as it was for students. *Brown* did not make any claims for the desegregation of teachers as schools integrated with one another. As a result, many African American teachers were dismissed from their jobs because white teachers were given priority in the integrated school market. Written only days after the passing of *Brown*, one *Chicago Defender* article noted that “Officials of several states have said they would not employ Negro teachers in integrated schools.” At Athens College in Alabama, the administration team bluntly denied the possibility of ever hiring African American teachers. *The Crisis* included a letter from the registrar of the college to the youth secretary of the NAACP in its June 1954 issue in which the registrar went so far as to proclaim “We will probably never hire any of them [African American teachers]. Your northers [*sic*] ‘Yankee’ friends will employ them. Not us.... Don’t insult us any more with such expectations.” Implementing widespread desegregation was only required at the student level, leaving many African American teachers vulnerable. Due to this lack of federal integration orders at the faculty level, African American teachers were stripped of any hope for job security,

<sup>23</sup> “High School at Clinton Dynamited: Tennessee Offers Reward of \$5000; FBI Joins Inquiry,” *Washington Post and Times Herald*, October 6, 1958, Proquest.

<sup>24</sup> “High School at Clinton Dynamited.”

<sup>20</sup> Constance Baker Motley, “Eyes on the Prize; Interview with Constance Baker Motley,” interview by Judith Vecchione, *American Archive of Public Broadcasting*, Library of Congress and WGBH, March 8, 1986, [https://americanarchive.org/catalog/cpb-aacip\\_151-zg6g15vcor](https://americanarchive.org/catalog/cpb-aacip_151-zg6g15vcor).

<sup>21</sup> “Percentage of Negro Pupils Drops in Dixie: Increases in Washington, D.C.,” *The Chicago Defender*, December 14, 1957, Proquest.

<sup>22</sup> Betty Jean Ward (African American Prince Edward County student) recounts a talk with her father, in Kristen Green, *Something Must Be Done About Prince Edward County: A Family, a Virginia Town, a Civil Rights Battle*, (New York: Harper Perennial, 2015), 149.

leaving many bitter. Some African American teachers did not want desegregation to take place because it cost them career opportunities and created a new system of exclusivity based upon de facto racism.<sup>25</sup>

## Opposition to Integration

One of the most prominent African Americans who spoke in opposition to the *Brown* decision was Zora Neale Hurston. Hurston was a Southern anthropologist, folklorist, and writer who showed no support for desegregation. Her views demonstrated a stark contrast to the dominant opinion of African Americans at the time; she was a fervent supporter of institutions separated by race. Hurston believed separate institutions preserved and promoted racial pride. She argued that desegregated schools put African American children in the position to feel inferior to their white peers and have to face this inferiority complex head-on. In a letter to the editor of a Florida paper, Hurston wrote, “How much satisfaction can I get from a court order for somebody to associate with me who does not wish me near them?” Hurston expressed her sentiments: “I regard the ruling of the U.S. Supreme Court as insulting rather than honoring my race.” Unlike many African Americans who reacted to the *Brown* decision with hopeful wariness, Hurston stated her contempt openly and called for others to express their frustrations. She believed there was no need for sympathy or respect for those who saw race as a “tragedy of color.” Hurston believed those who shared these opinions overlooked the possible benefits of segregated education and that groups rallying in support of *Brown* did not consider all the factors and effects of the Supreme Court’s decision before pressuring others to support it. She continued her support for segregated education and her preference for equalization by explaining, “Negro schools in the state are in very good shape and on the improve.” In Hurston’s eyes, equalization and gradualism proved a more promising movement toward equal rights for African Americans than forced progress.<sup>26</sup>

## Massive Resistance

Virginia Senator Harry F. Byrd’s immediate response represents the intense backlash and criticism surrounding *Brown*. He argued it was “the most serious blow that has been struck against the rights of the states in a matter vitally affecting their authority and welfare.”<sup>27</sup>

<sup>25</sup> Darrell Garwood, “Kill Jim Crow Schools: U.S. Supreme Court Rules Unanimously in Ending Segregation in Education,” *The Chicago Defender*, May 22, 1954, Proquest; F. D. Ward, letter to Herbert L. Wright, 2 June 1954, *The Crisis*, June-July 1954, 336.

<sup>26</sup> Zora Neale Hurston, “Court Order Can’t Make Races Mix,” letter to the editor, *Orlando Sentinel, The Public Thought*, August 11, 1955, quoted in Martin Jr., “*Brown v. Board of Education*,” 209-212.

<sup>27</sup> For a biography of Harry F. Byrd, see Ronald L. Heinemann, *Harry Byrd of Virginia*

Byrd believed the Supreme Court’s decision for school integration was outside the federal government’s jurisdiction and scope, and he reacted defiantly when other state officials suggested compliance to *Brown*. As head of Virginia’s Democratic Party machine, Byrd rallied support against integration throughout the state. Byrd did not conduct his agenda publicly, however, but gathered support behind the scenes through persuasion of other Virginia government officials, such as Governor Thomas B. Stanley.<sup>28</sup>

***Byrd used his political prowess, knowledge of loophole manipulation, and persuasive speech to change minds from compliance to resistance.***

Byrd used his political prowess, knowledge of loophole manipulation, and persuasive speech to change minds from compliance to resistance. He began by working with his Southern colleagues in the District of Columbia to prepare for an all-Southern resistance gesture. He also supported the idea of interposition, in which a state had a right to “interpose its sovereignty” between its citizens and the federal government. In these subtle ways, Byrd persuaded other Virginia and Southern officials. Governor Thomas B. Stanley’s change of heart was most evident, as he initially accepted the *Brown* decision in May 1954, but within two short months threatened to use all of his power to continue segregated schools in Virginia. By September 1954, Stanley called for a board, known as the Gray Commission,<sup>29</sup> to discuss *Brown* and determine the best course of action to resist its implementation. Stanley’s stance completely changed, as his original words—“I am confident the people of Virginia will receive the opinion of the Supreme Court calmly and take time to carefully dispassionately consider the situation before coming to conclusions on steps which should be taken”—became null at the hands of Byrd’s influence. Byrd’s puppeteering caught the attention of notable officials and gained momentum.<sup>30</sup>

(Charlottesville: University Press of Virginia, 1996).

<sup>28</sup> “Governor to Call Meeting of State Leaders on School Problem: Stanley Sees No Need Now for Assembly Meeting,” *Richmond Times-Dispatch*, May 18, 1954; Muse, *Virginia’s Massive Resistance*, 26; Brian J. Daugherty, “Keep on Keeping On: African Americans and the Implementation of *Brown v. Board of Education* in Virginia,” in *With All Deliberate Speed: Implementing Brown v. Board of Education*, eds. Brian J. Daugherty and Charles C. Bolton (Fayetteville: University of Arkansas Press, 2008), 43-44.

<sup>29</sup> A commission appointed by Governor Thomas B. Stanley in August 1954. The purpose of the Gray Commission was to investigate the effects of the *Brown* decision and to make implementation recommendations to the Virginia legislature. All members of the commission were white, male legislators from the Fourth District (Southside) of Virginia, where the state had its most concentrated African American populations. By November 1955, the Gray Commission provided its final report, where they offered the idea of a “local option,” which granted each locality in the state the right to process desegregation at its own speed, and recommended amending the Virginia State Constitution, Section 141, to allow “tuition grants” to white parents for the private education of their children.

<sup>30</sup> Muse, *Virginia’s Massive Resistance*, 22, 27; Brian J. Daugherty, “Keep on Keeping On,” 44; “Governor to Call Meeting,” *Richmond Times-Dispatch*, May 18, 1954.

Byrd encouraged his resistance agenda amongst other Southern representatives in DC more aggressively two years after the original *Brown* decision. Southern senators and representatives deliberated this agenda set in opposition to integration. On March 12, 1956, Georgia Senator Walter George introduced the infamous “Declaration of Constitutional Principles,” which would later be known as the Southern Manifesto. The document made headlines as it publicly contested the federal government’s involvement and claimed, “This unwarranted exercise of power by the court, contrary to the Constitution, is creating chaos and confusion in the states primarily affected.” Furthermore, the *Brown* decision was “destroying the amicable relations between white and Negro races that have been created through ninety years of patient effort by the good people of both races. It has planted hatred and suspicion where there has been heretofore friendship and understanding.” This declaration exhibited the first strong example of Massive Resistance. The opposition movement would exist in the South for the next decade, especially after *Brown II*’s (1955) “all deliberate speed” ruling,<sup>31</sup> which made integration difficult for the federal government to enforce. Massive Resistance was a strategic movement that utilized state legislation to prevent school integration by passing laws and policies in opposition. Byrd endorsed its development and publication along with Senator Strom Thurmond of South Carolina, who wrote the early drafts of the Southern Manifesto. Thus, Byrd secured his place as the founder of the Massive Resistance movement that would permeate the South.<sup>32</sup>

***Massive Resistance was a strategic movement that utilized state legislation to prevent school integration by passing laws and policies in opposition.***

While his “behind closed doors” and “official” proceedings occurred amidst other Southern representatives, Byrd continued to rally support for resistance in his home state of Virginia. On July 2, 1956, he called Governor Stanley, State Senator Garland Gray, and other reliable leaders of his political organization for a secret conference to discuss the necessary action for defiance. During the meeting, Byrd convinced these officials to charge full speed ahead in their anti-integration efforts through legislative measures. He also convinced Stan-

ley to hold a special session to discuss Virginia’s plan of resistance. In compliance with this suggestion, Stanley called for a special legislative session of the Virginia General Assembly on August 27, 1956. The session was held in Richmond and lasted twenty-seven days. During this time, they passed twenty-three acts regarding the school segregation issue. Passing these acts began the legislative crusade of Massive Resistance in Virginia. Though the legislators claimed the concept of “local option” was in practice, schools that opted for integration would be promptly “closed and removed from the public-school system.”<sup>33</sup>

## **Spread of Massive Resistance**

Virginia’s resistance created a path for other states, such as Georgia, to follow. Prior to *Brown*, Georgia was in the process of making plans for state school equalization, regardless of the resistance within the state. Many white Georgians maintained similar sentiments and agendas as their Deep South and Virginia counterparts, with varying expressions of defiance and resistance. To ensure the legal nullification of the *Brown* decision, Georgia government officials created a proposal that provided educational vouchers to students via the state and local governments. The vouchers would separate children of different races without technically constituting “discrimination;” this proposal became known as the “private school plan.” It received backlash nationwide by both whites and African Americans once it passed as an amendment to the state’s constitution. This new amendment provided the Georgia state legislature with a green light to propose and pass more anti-integration laws, under the condition that these laws would not pose legal challenges or explicitly contradict the federal ruling. The resulting laws and other legislation passed in Georgia, such as the ability to close public schools that were federally ordered to desegregate, became part of the Massive Resistance movement as other Southern states followed these procedures. As long as school segregation fit within the legal jurisdiction of states, integration would be resisted with “all deliberate speed.” The “private school plan” amendment displayed Southern segregationists’ determination to preserve an institution teeming with discrimination and ignorance.<sup>34</sup>

Segregationists did not exist solely in the Southern states. Former border states, such as Delaware, employed considerable resistance against school integra-

<sup>31</sup> “With all deliberate speed” was a portion of the *Brown II* ruling which allowed local school boards to integrate African American and white students at a pace they deemed appropriate. This vague phrase enabled many Southern states to slow down, and even halt, any progress of the original *Brown* decision. Though this phrase was intended by the Supreme Court to soften the blow of inevitable integration, it resulted in greater resistance by states.

<sup>32</sup> Wilhoit, *Politics of Massive Resistance*, 51-53; “96 Congressmen’s Declaration on Integration” *New York Times*, 12 March 1956.

<sup>33</sup> Muse, *Virginia’s Massive Resistance*, 28-31.

<sup>34</sup> Thomas V. O’Brien, “Defiance, Protest, and Compromise: The Struggle to Implement *Brown* in Georgia, 1950-1973,” in *With All Deliberate Speed: Implementing Brown v. Board of Education*, eds. Brian J. Daugherty and Charles C. Bolton (Fayetteville: University of Arkansas Press, 2008), 95-96.

tion. Many Delaware citizens held Southern-minded and traditionalist views pertaining to segregation, despite a small African American population. When there was a shortage of funding for higher education, Delaware officials proposed integrating Delaware State College, a historically African American college, and the University of Delaware, a historically white institution; both African American and white citizens of the state opposed the plan. Though some school districts were integrated, which received praise from northern neighbors, the *Brown* decision incited cruel and hateful opposition in other communities in the state, such as Milford in the fall of 1954. When school began in September, the formerly white high school in Milford admitted eleven African American students for the school year. By September 20, the local government closed all Milford schools indefinitely in an act of resistance. One week later, Milford High School reopened. State and local police were present as protestors threatened white and African American students alike for attending class. Some groups, such as the National Association for the Advancement of White People (NAAWP), went so far in their hate crimes as to hand out sheets of hateful messages, call and threaten African American parents for sending their children to a formerly white-only school, and scratch the names of the Milford Eleven from enrollment records. The “Milford Incident,” as it was commonly referred to, showcased how Massive Resistance became practiced in multiple states within the turn of a year.<sup>35</sup> This incident exemplifies the direct opposition over the outcome of *Brown*.

## Conclusion

The *Brown* decision caused an uproar across the United States. Integration would not be fully implemented until an entire decade after the Supreme Court’s initial decision. The Massive Resistance movement maintained a steady prominence during this time, as many states continued to defy the federal government’s jurisdiction. *Brown* challenged the infrastructure of Southern society, which was based on Jim Crow laws and institutional segregation to maintain the “inferior” status of African Americans. Though this landmark case was a great victory for the American civil rights movement in the 1950s and 1960s and the advancement of equality among all citizens, its ambiguity and brevity helped little in the guidance of racial issues and proper means of desegregating public schools.

*Brown* served as a catalyst for cultural and legislative

change. The decision affected every American, providing a broad spectrum of emotional sentiments regarding its ruling. Many people on both sides believed the decision was merely a “cultural shock” and “quick fix” to a larger and more deeply embedded social problem in America. The acceptance or defiance of *Brown*, and of the larger civil rights movement, was not a position taken by groups wholly as Americans are often taught. This distorted narrative too broadly simplifies an event and movement which called each American to reflect on their personal values and what is meant by the idea of equality.<sup>36</sup>

<sup>35</sup> Bradley Skelcher, “Promises of *Brown*: Desegregating Education in Delaware, 1950-1968” in *With All Deliberate Speed: Implementing Brown v. Board of Education*, eds. Brian J. Daugherty and Charles C. Bolton (Fayetteville: University of Arkansas Press, 2008), 155-161; June Shagaloff, “Desegregation of Public Schools in Delaware,” *The Journal of Negro Education* 24, no. 3 (1955): 197-198, <https://doi.org/10.2307/2293451>.

<sup>36</sup> Wilkinson III, *From “Brown” to “Bakke,”* 48-49.



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Haylee would like to thank Dr. Hyser for his constant support, advice, and encouragement over the course of this project and her collegiate career. She would also like to thank the *JMURJ* Editorial Board for their aid in refining her paper for publication.

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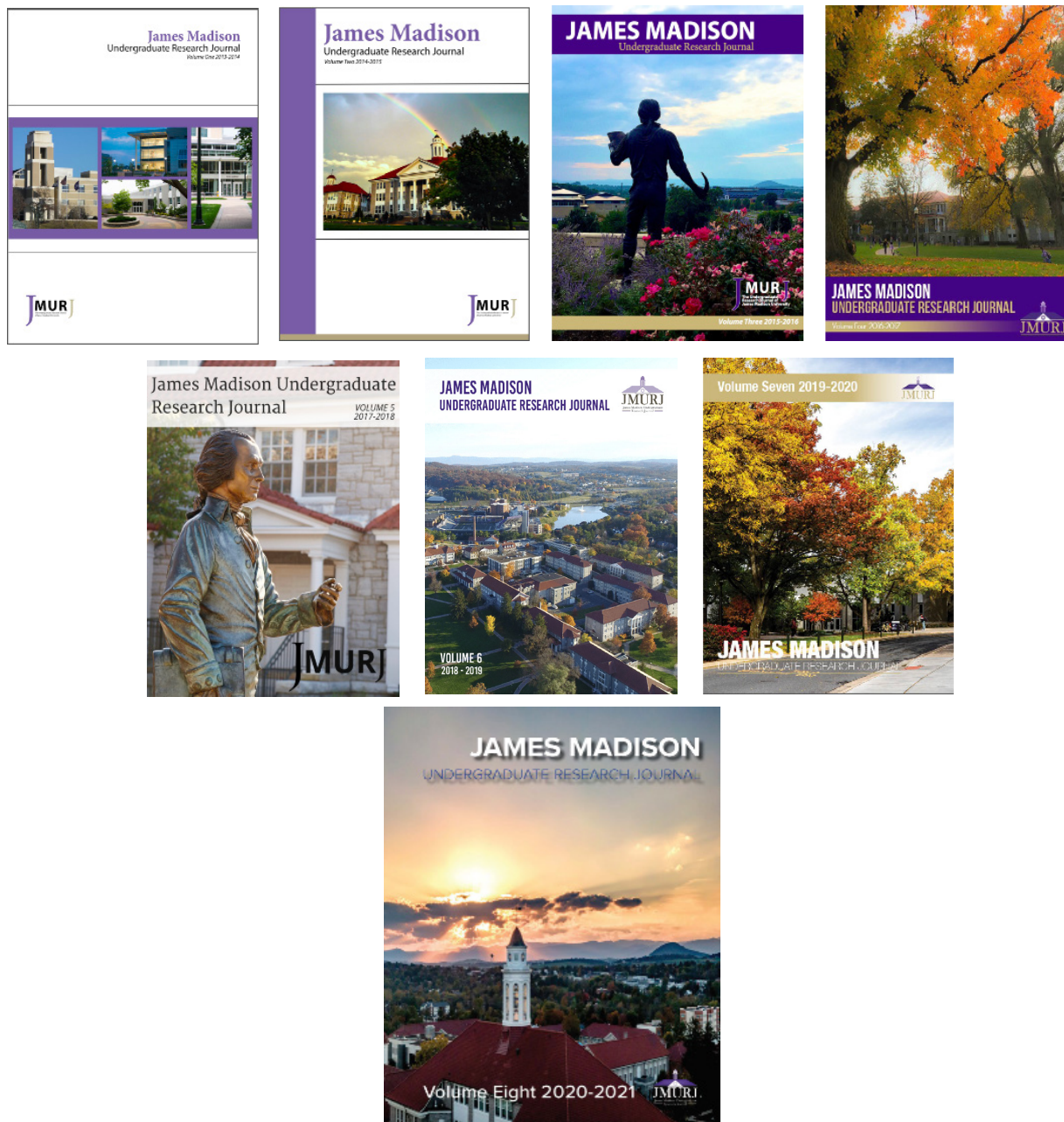
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