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# Nonverbal synchrony as a behavioral marker of patient and physician race-related attitudes and a predictor of outcomes of oncology interactions: A cross-sectional study of video-recorded cancer treatment discussions

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## Abstract

**Introduction:** Racial disparities in cancer treatment contribute to racial mortality disparities. The quality of patient-physician communication during clinical interactions with Black patients (racially discordant) is poorer than communication quality in clinical interactions with White patients (racially concordant). Patient and physician race-related attitudes affect the quality of this communication. These attitudes are likely expressed through subtle nonverbal behaviors; prior research has not examined these behaviors or the ways they are expressed. Nonverbal synchrony, the coordination of physical movement, reflects pre-interaction attitudes *and* predicts participants' post-interaction perceptions of and affect toward one another. We investigate nonverbal synchrony in racially concordant and racially discordant interactions to better understand racial disparities in clinical communication.

**Methods:** Data include racially concordant (n=163) and racially discordant (n= 68) video recorded oncology interactions, patient and oncologist self-reported race-related attitudes, post-visit perceptions of the interaction, and observer ratings of physician's patient-centered communication, and patient and physician affect and rapport. Aim 1 assesses and compares nonverbal synchrony between physicians and patients in racially concordant and racially discordant interactions, using software that can assess nonverbal synchrony. Aim 2 determines the influence of nonverbal synchrony on patient and physician affect and communication in racially concordant and discordant interactions. Aim 3 examines possible causes (i.e., race-related attitudes) and consequences (i.e., negative perceptions) of nonverbal synchrony in racially discordant interactions. Aim 4 develops and tests a mediational model linking physician and patient race-related attitudes to nonverbal synchrony and, in turn, interaction outcomes.

**Analysis**: A hierarchical linear model will model changes in nonverbal synchrony comparing racially concordant or racially discordant interactions. Multilevel structural equation modeling will test proposed mediations.

**Ethics and dissemination**: The parent and current studies are IRB-approved. Since only archival data will be used, ethical or safety risks are low. We will disseminate our findings to communication, psychology, and oncology conferences and journals.


**Key Word: Nonverbal Synchrony; Disparities; Cancer; Racial Discordance; Race-related Attitudes**

**Strengths and limitations of this study:**

- This study explores a channel of communication in medical interactions that has not been previously examined.
- This study utilizes video-recorded cancer treatment discussions of Black and White patients with cancer recorded with state-of-art recording equipment.
- This study utilizes automated behavioral coding software, which introduces less error than traditional methods using human coders.
- This study takes advantage of existing datasets, but the video-recorded and self-report data were not collected with the current hypotheses in mind.
- The data are not evenly distributed by sex and race.

## INTRODUCTION

Racial disparities in cancer mortality and treatment are well documented. In the United States, deaths due to cancer are approximately 20% higher for Blacks than for Whites.[1] This mortality disparity remains even after controlling for stage at diagnosis, disease aggressiveness, obesity, comorbidities, physician access, insurance status, and referrals.[2-6] Importantly, this disparity is greatest for the most treatable cancers.[7] This strongly suggests treatment disparities may contribute to mortality disparities.[8-14] For example, Black cancer patients are less likely to receive chemotherapy for leukemia, breast, lung, and colorectal cancers. If they do receive treatment, it is more likely to be delayed or nonstandard.[2,8,15-23] Although multiple causes of these treatment disparities exist, we focus on two likely contributors: 1) poor patient-physician communication during oncology interactions,[24-30] and 2) race-related attitudes of physicians and patients.[31-42]

Black patients experience poorer quality communication during racially discordant oncology interactions compared to similar interactions with White patients. Due to the small number of Black physicians, especially Black oncologists,[43] about 80% of Black patients' clinical interactions are racially discordant (Black patients, non-Black physicians).[44] Patient-physician communication is often of poorer quality in racially discordant clinical interactions than racially concordant ones. Patients in racially discordant interactions tend to ask fewer questions[25] and are less likely to participate in decision making;[45] whereas physicians tend to be less patient-centered;[46,47] more verbally dominant;[47] more contentious;[48] exhibit fewer rapport building nonverbal behaviors;[49] and provide less information.[27] Physicians and patients show fewer expressions of positive affect [47] and relationship-building attempts.[29]

Patient and physician race-related attitudes affect interaction outcomes via communication behaviors. Prior research, including our own, suggests that *race-related attitudes* (e.g., physician implicit bias against Blacks; patient suspicion of medical care Blacks receive) affect communication in clinical interactions and perceptions physicians and patients have of each other during racially discordant clinical interactions.[31-33,37,38] For example, physicians with higher levels of implicit (nonconscious) bias against Blacks are perceived as less patient centered and less trustworthy by their Black patients.[31,40,41,50] Our prior research suggests such perceptions and behaviors are associated with less positive patient expectations about recommended treatments.[51] We have also found that Black patients with higher levels of suspicion of medical care are less optimistic about outcomes of recommended treatments and are perceived by their physicians to be less educated.[52,53] This, in turn, is associated with less positive physician expectations about how their Black patients will do on a treatment protocol, such as their adherence and/or ability to tolerate treatment. Given that these attitudes are not directly observable, the only possible way in which they can affect perceptions and expectations is through their impact on communication behaviors.

Relatively little is known about *how* race-related attitudes are manifested in communication behaviors during oncology interactions or the effects of communication on interaction outcomes. Our own and others' research has shown that non-Black physicians' nonconscious race-related attitudes (i.e., implicit racial bias) influence their communication with Black patients.[51,54-56] Studies of nonmedical interracial interactions find that implicit bias is more likely to be expressed through less deliberate nonverbal communication (e.g., facial expressions, posture) than through more deliberate verbal communication (i.e., spoken words).[57-60] Black patients' communication may be driven more by explicit than implicit race-related attitudes,[61] but its

expression also seems to be subtle and involve less deliberate communication (e.g., nonverbal behaviors). The behavioral channels through which these race-related attitudes are expressed are not known, but nonverbal synchrony is a promising candidate as one of them.

Considerable prior research shows that nonverbal synchrony, or the coordination of physical movement that occurs between individuals during an interaction,[62] is often nonconscious, unintentional, and effortless.[63-65] However, nonverbal synchrony can be predicted by pre-interaction attitudes[66] and has post-interaction consequences.[67] People synchronize more with others with whom they have positive relationships,[68] those with whom they want to develop positive relationships,[69] and others whom they trust.[66] In a recent experimental lab-based study, individuals with higher implicit bias synchronized more with an avatar of their own race than with an avatar of a different race.[70] In terms of nonverbal synchrony's role as a predictor, nonverbal synchrony reflects more subsequent positive affect and liking,[67] perceptions of similarity, closeness, and rapport with the interaction partner.[66,71,72] More relevant to clinical communication, nonverbal synchrony has been found to positively influence therapeutic processes,[73] cooperation,[74] obedience,[72] and memory for information provided by the interaction partner.[75,76]

In sum: we know that Black patients and non-Black physicians react to each other's race-related attitudes. We know that these attitudes are likely subtly manifested in communication. Little is known, however, about the channels through which these attitudes are communicated. Because nonverbal synchrony is subtle, unintentional, automatic and affect-laden, it may likely serve as a behavioral marker of race-related attitudes. The current study will help fill this gap in understanding by examining the role of nonverbal synchrony in racially concordant and racially discordant oncology interactions.

The study was designed to achieve the following *aims* and *hypotheses*:

Aim 1: Assess and compare nonverbal synchrony between physicians and patients in racially concordant and racially discordant oncology interactions.

Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in racially discordant oncology interactions.

Aim 2: Determine the influence of nonverbal synchrony on physician communication style (e.g., patient centered) and patient and physician affect in racially concordant and racially discordant oncology interactions.

Hypothesis 2: Nonverbal synchrony will influence physician patient-centered communication, patient and physician affect, and relational rapport in racially concordant and racially discordant clinical interactions.

Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially discordant oncology interactions.

Hypothesis 3: In the racially discordant oncology interactions, nonverbal synchrony will significantly negatively covary with patient post-interaction distress and positively covary with 1) patient post-interaction perceptions of physicians' patient-centered communication and treatment expectations, 2) physicians' post-interaction perceptions of patient personal characteristics (e.g., understanding of treatment options), and their responses to treatment (e.g., willingness to follow treatment regimen), and 3) observers' ratings of physician patient-centered communication, patient and physician affect, and relational rapport.

Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction race-related attitudes of the patient and physicians (e.g. physician implicit bias; patient suspicion).

Aim 4: Develop and test a mediational model that links physician and patient race-related attitudes to nonverbal synchrony and, in turn, outcomes of racially discordant oncology interactions.

Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-interaction race-related attitudes and post-interaction perceptions of the patients and physicians.

## METHODS AND ANALYSIS

**Overview of proposed study**. Our goals are to: 1) compare the extent to which physicians and patients synchronize their behavior in racially concordant and racially discordant oncology interactions, 2) compare the associations between nonverbal synchrony and self-report and observational measures of patient and physician affect and physicians' patient-centered communication in racially concordant and racially discordant oncology interactions, 3) investigate how race-related attitudes (e.g., physician implicit bias; patient suspicion) affect nonverbal synchrony in racially discordant oncology interactions, 4) investigate how nonverbal synchrony affects the outcomes of racially discordant clinical interactions, and 5) test the conceptual model in Figure 1, which predicts that race-related attitudes will be associated with patient and physician perceptions and treatment-related outcomes of racially discordant oncology interactions, through their influence on nonverbal synchrony. To achieve these goals, we will conduct a secondary analysis of data from two studies conducted by members of our study team. **Study One,** conducted at two NCI-designated comprehensive cancer centers (R01CA75003),[77]

was an investigation of how patient-oncologist communication influences patients' decision making about treatment including clinical trials. **Study Two,** conducted at one of the **Study One** NCI-designated centers plus another large urban cancer clinic, investigated associations between communication and outcomes during racially discordant oncology interactions (U54CA153606-04). [78 78] Patients and oncologists from both studies who agreed to secondary analyses of their recordings will be used in the current study. Comparisons of groups did not find any socio-demographic or attitudinal differences between patients/oncologists who did and did not agree to be in secondary analyses.

**Data Sources.**

*Participants, Procedures, and Measures in Study One.* Patients from **Study One** who are in the current study include 163 self-identified White (92 male; 71 female) patients who saw a non-Black medical oncologist to discuss treatment. Prior to meeting their oncologist, patients completed a survey assessing their sociodemographic characteristics. Exam rooms were equipped with unobtrusive digital audio and video recording devices; studies have demonstrated the nonreactance to the recording process,[79] and enhanced validity compared to audio recording alone.[80] Oncologists were 22 non-Black male medical oncologists (no female oncologists participated in **Study One**) video recorded in at least one interaction ($M$ = 7.4 $SD$ = 7.0). Upon enrollment, oncologists completed a demographic survey.

*Participants, Procedures, and Measures in Study Two.* Patients from **Study Two** who are in the current study include 68 Black female patients who saw a non-Black medical oncologist to discuss treatment. Only 6 of the patients in Study Two were males, thus, they will be excluded from this study. Oncologists are 13 (7 females; 6 males) non-Black medical oncologists who were video recorded in at least one interaction ($M$ = 5.2, $SD$ = 6.4).

*Measures*: At baseline, patients provided sociodemographic information and completed measures of suspicion of medical care Black patients receive[34] and trust in physicians.[81] At baseline, oncologists completed a demographic survey and completed the Implicit Association Test (IAT), which assesses implicit racial bias against Black people.[82] The video-recorded clinical interations interactions took place several weeks later. Immediately after the interactions, patients completed measures of distress, perception of the physicians' patient-centered communication, and expectations about recommended treatment. Also, immediately after interactions, oncologists completed measures of perceptions of the patient and how well the patient would do in treatment. One week later, patients reported their leve of trust in their oncologist in a telephone survey. Trained observers later observed and rated video recorded interactions to assess physicians' patient-centered communication.[48] At least two observers rated physician communication; inter-rater reliability was acceptable (ICC = .57-.74, *p*'s<.05). Each physician's patient centeredness score was the average of multiple observer ratings.

Five one-minute video slices were created from each of the recordings (N = 340 slices) by dividing each video recording into five equal segments and selecting the first minute from each segment.[57,83-85] The slices were rated by naïve observers for patient and physician affect (e.g. warm/friendly,) and relational rapport (e.g. attentive).

**Hypotheses and Data Analysis.**

**Aim 1: Assess and compare nonverbal synchrony between physicians and patients in racially concordant and racially discordant oncology interactions.** We will achieve this aim by first matching video recordings from **Study One** and **Study Two** on patient and physician sex and other sociodemographics. Although our focus is on racial concordance/discordance, prior research suggests that patient and physician sex affects communication in medical interactions.[86-

[90] However, as described above, matching on sex is constrained by the distributions in the original recordings. Thus, from **Study One,** we will use 71 White female patients and 92 White male patients who interacted with male non-Black physicians. From **Study Two,** we will use the 34 Black female patient-non-Black male physician dyads and 34 Black female patient-non-Black female physician interactions. Thus, within race concordant and race discordant interactions we will examine the effects of sex concordance and discordance. We acknowledge that this is not a full factorial design, but it will permit us to examine the influence of race concordance/discordance on nonverbal synchrony and, also partially examine whether the influence of race on nonverbal synchrony is moderated by patient and physician sex. To minimize any other differences between Black and White patients, we will also do block matching of patients from **Study One** with patients from **Study Two** on characteristics that might affect nonverbal communication (e.g., age, type of cancer). We expect this matching will reduce the number of patients available from **Study One** by 20-30% percent, but sufficient cases will be available for well-powered analyses of racial concordance/discordance. We will then further the equivalence of patients with advanced methods of propensity scoring.[91-93]

We will assess nonverbal synchrony in all matched interactions using customized Motion Energy Analysis (MEA; http://psync.ch/?p=9)[73,94] software to obtain a synchrony index for each interaction. Figure 2 is a screenshot of MEA. MEA is an objective automated method that continuously monitors the amount of movement occurring in pre-defined regions of interest.[73,95,96] MEA captures frame-by-frame movement and provides quantification of change in movement in the regions of interest. We consider each individual as one region of interest to capture full body movement. MEA uses pixel-differencing methods to measure total amount of movement. We will quantify nonverbal synchrony by deriving scores using windowed cross-

correlation (WCC) matrices to obtain a synchrony index for each interaction.[97] Nonverbal synchronization of interaction tends to ebb and flow during conversations and thus is nonstationary.[91] WCC accounts for the possibility of nonstationary synchronization when comparing two time series by comparing small sections of the time series at a time at different time lags. Figure 3 is WCC output displayed as a heat map with warmer colors representing strong positive correlations between the two individuals' behavior and cooler colors representing strong negative correlations. These scores are dyadic attributes that represent amounts and relationships of synchronous movement within dyads. Then we will compare (a) effects of race concordance versus discordance on nonverbal synchrony and (b) effects of sex concordance versus discordance on nonverbal synchrony, and (c) determine the relative impact of race concordance/discordance versus sex concordance/discordance on nonverbal synchrony.

*Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in racially discordant oncology interactions*. To obtain time varying synchrony scores, we will block each interaction into five equal segments and obtain synchrony indices for each segment using MEA. This procedure also allows us to adjust for patients and physicians moving outside of the regions of interest set at the beginning of each segment and maximizes the likelihood that we capture all patient and physician movement. To model changes in dynamic and overall levels of synchrony, we will use structural equation modeling (SEM) methods, latent differential equations (LDE), and multi-level modeling (MLM) methods. LDE is a special case of SEM that allows for estimation of parameters of a proposed underlying dynamical system. LDE models contain parameters pertaining to the dynamics of a given system (e.g., "eta" and "zeta" parameters of a latent harmonic oscillator model). We will use multi-group SEM modeling to test for differences in these parameters between racially concordant and racially discordant interactions. By using a

likelihood ratio test comparing two models where 1) these dynamic parameters are free to vary and 2) where these parameters are constrained to be equal across models, we will be able to determine if the motion dynamics differ between racially concordant and racially discordant interactions. Using a three-level HLM model with time segments (level-1) nested within patient (level-2), and patient nested within physician (level-3), we will model changes in nonverbal synchrony based on a categorical variable modeling either racially concordant or racially discordant interactions. Assuming 168 dyads, an alpha of .05, a correlation coefficient of .1, and a linear time effect, we have a power of .8 to detect a medium effect size of .50.

**Aim 2: Determine the influence of nonverbal synchrony on physician communication and patient and physician affect in racially concordant and racially discordant oncology interactions.** We will first collect the same observational measures for **Study One** as in **Study Two**. Trained research assistants will rate each of the racially concordant interactions on physicians' patient-centered communication.[48] Next, we will create thin slices of the interactions from **Study One** – naïve observers will rate the slices using the same measures of physician-patient affect and rapport as in **Study Two**. Then we will use the synchrony indices from Aim 1 to compare the relationship between nonverbal synchrony and patient-physician affect and rapport in racially concordant and discordant interactions.

*Hypothesis 2: Nonverbal synchrony will influence physician patient-centered communication, patient and physician affect, and relational rapport in racially concordant and racially discordant clinical interactions.* We will use MLM and multi-group SEM to create a mediation model where nonverbal synchrony will predict level-2 (patient) and level-3 (physician) outcomes. Assuming 168 dyads, an alpha of .05, and a correlation coefficient of .1, we have power of .8 to detect an effect size of .48.

**Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially discordant oncology interactions.** We will achieve this aim using the synchrony indices from the racially discordant interactions in **Study Two**. We will examine the relationships between nonverbal synchrony and: 1) interaction outcomes including: patient satisfaction, distress, perception of physicians' patient-centered communication, and treatment expectations, and physician perceptions of the patient (e.g., willingness to follow treatment regimen), and 2) pre-interaction physician and patient race-related attitudes (e.g., implicit bias; suspicion).

*Hypothesis 3: In the racially discordant oncology interactions, nonverbal synchrony will significantly negatively covary with patient post-interaction distress and positively covary with 1) patient post-interaction perceptions of physicians' patient-centered communication and treatment expectations, 2) physicians' post-interaction perceptions of patient personal characteristics (e.g., understanding of treatment options), and their responses to treatment (e.g., willingness to follow treatment regimen), and 3) observers' ratings of physician patient-centered communication, patient and physician affect, and relational rapport.* Using LDE, we will model dynamic parameter values of the fluctuations in nonverbal synchrony over the course of each interaction. These values will then be used as first level predictors in a MLM model. The second level predictors for this model will be values associated with physician and patient post interaction perceptions of the interaction and of each other. Assuming 68 dyads, an alpha of .05, and a correlation coefficient of .1, we have a power of .9 to detect an effect size of .56.

*Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction race-related attitudes of the patient and physicians (e.g. physician implicit bias; patient suspicion).* We will create a three-level MLM. We will model synchrony assessed over five time segments nested

within each patient and each patient nested within physician. Each patient-physician dyad will have its own average synchrony score.

**Aim 4: Develop and test a mediational model that links physician and patient race-related attitudes to nonverbal synchrony and, in turn, outcomes of race-related discordant oncology interactions.**

*Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-interaction race-related attitudes and post-interaction perceptions of the patients and physicians*. To examine the proposed mediations in a multilevel context, we will utilize multi-level SEM, as described by Preacher and colleagues.[98,99] These models address potential conflated estimates of mediated effects that can arise when using multi-level data. Time segments will be nested within each patient and each patient will be nested within physician, with synchrony varying at each time point. We will use a single mediation model to assess how physician and patient race-related attitudes impact interaction outcomes via their impact on nonverbal synchrony.

## ETHICS AND DISSEMINATION

Studies one, two, and the current study are all IRB-approved. Only patients and physicians from the previous studies who provided their consent for secondary analyses of their data were include in the current study. The nature of the data make it unlikely we will encounter ethical or safety issues.

We will submit our ongoing findings to relevant communication, social psychology, and oncology conferences. Similarly, we plan to submit the final manuscripts to high-impact communication, social psychology, and oncology peer-reviewed journals.

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**Authors' Statement:**

LMH: Principal Investigator, involved in all aspects of conceptualization and study design.

RM: Research Assistant, involved in the study design and responsible for design and implementation of statistical anlayses.

TLA: Co-Investigator, involved in all aspects of conceptualization and study design.

SB: Co-Investigator, involved in all aspects of conceptualization and study design and responsible for design and implementation of statistical analyses.

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# Figures

Figure 1: Conceptual Model

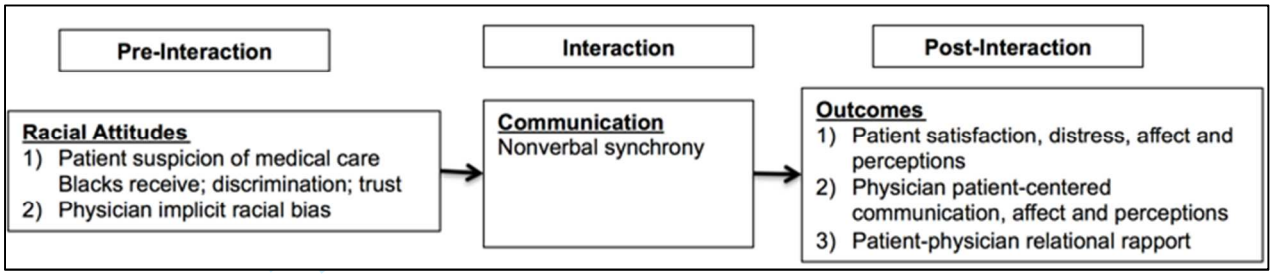



Figure 2: Motion Energy Analysis Software

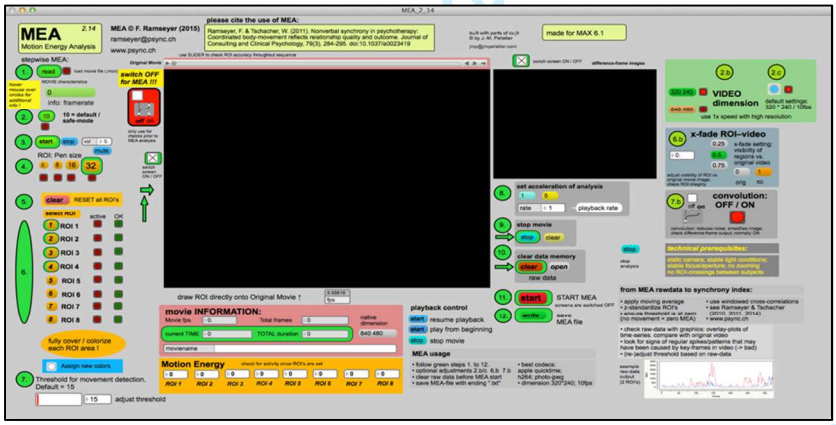
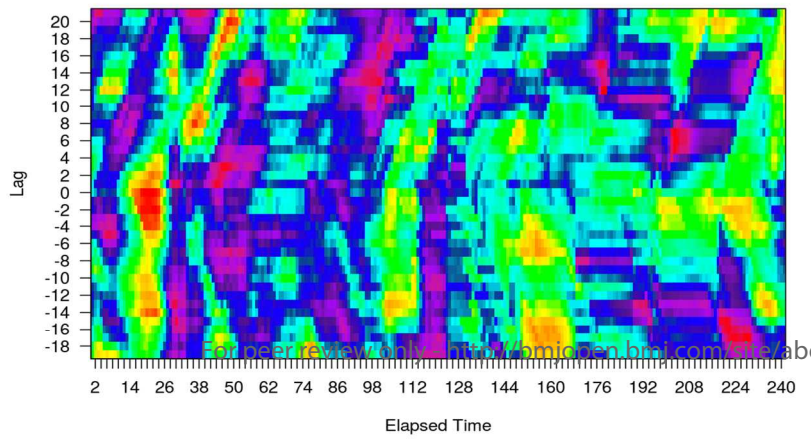



Figure 3: Window Cross Correlation Output



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# Nonverbal synchrony as a behavioral marker of patient and physician race-related attitudes and a predictor of outcomes in oncology interactions: Protocol for a secondary analysis of video-recorded cancer treatment discussions

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## Abstract

**Introduction:** Racial disparities in cancer treatment contribute to racial disparities in mortality rates. The quality of patient-physician communication during clinical interactions with Black patients and non-Black physicians (racially discordant) is poorer than communication quality in with White patients (racially concordant). Patient and physician race-related attitudes affect the quality of this communication. These attitudes are likely expressed through subtle nonverbal behaviors, but prior research has not examined these behaviors. Nonverbal synchrony, the coordination of physical movement, reflects the pre-interaction attitudes of participants in interactions *and* predicts their post-interaction perceptions of and affect toward one another. In this study, peer reviewed and funded by the National Institute of Minority Health and Health Disparities (R21MD011766), we will investigate nonverbal synchrony in racially concordant and discordant interactions to better understand racial disparities in clinical communication.

**Methods and analysis:** This secondary analysis includes racially concordant (n=163) and racially discordant (n=68) video-recorded oncology interactions, patient and oncologist self-reported race-related attitudes, perceptions of the interaction; and observer ratings of physician patient-centered communication and patient and physician affect and rapport. In Aim 1, we will assess and compare nonverbal synchrony between physicians and patients in racially concordant and discordant interactions. In Aim 2, we will determine the influence of nonverbal synchrony on patient and physician affect and communication. In Aim 3, we will examine possible causes (i.e., race-related attitudes) and consequences (i.e., negative perceptions) of nonverbal synchrony in racially discordant interactions. In Aim 4, we will develop and test a mediational model linking physician and patient race-related attitudes to nonverbal synchrony and, in turn, interaction outcomes.

**Ethics and dissemination**: The parent and current studies are IRB-approved. Since only archival data will be used, ethical or safety risks are low. We will disseminate our findings to communication, psychology, and oncology conferences and journals.


**Key Word: Nonverbal Synchrony; Disparities; Cancer; Racial Discordance; Race-related Attitudes**

**Strengths and limitations of this study:**

- This study explores nonverbal synchrony, a channel of communication that has not been previously examined in medical interactions.
- This study utilizes video-recorded cancer treatment discussions of Black and White patients with cancer, recorded with state-of-art recording equipment.
- This study utilizes automated behavioral coding software, which introduces less error than traditional methods using human coders.
- This study takes advantage of existing datasets, but the video-recorded and self-report data were not collected with the current hypotheses in mind.
- The data are not evenly distributed by sex and race.

## INTRODUCTION

Racial disparities in cancer mortality and treatment are well documented. In the United States, deaths due to cancer are approximately 20% higher for Black patients than for White patients.[1] This mortality disparity remains even after controlling for stage at diagnosis, disease aggressiveness, obesity, comorbidities, physician access, insurance status, and referrals.[2-6] Importantly, this disparity is greatest for the most treatable cancers.[7] This strongly suggests treatment disparities may contribute to mortality disparities.[8-14] For example, Black patients with cancer are less likely to receive chemotherapy for leukemia, breast, lung, and colorectal cancers. If they do receive treatment, it is more likely to be delayed or not adherent to the treatment guidelines set by the National Comprehensive Cancer Network.[2,8,15-23] Multiple causes of these treatment disparities exist including tumor biology, socioeconomic status, environment, and access to care.[6] However, research clearly shows that even when these factors are controlled, racial disparities in treatment remain. We focus on two other contributors to racial disparities in cancer treatments: 1) poor patient-physician communication during oncology interactions,[24-30] and 2) race-related attitudes and perceptions of physicians and patients.[31-42]

Black patients experience poorer quality communication during oncology interactions compared to similar interactions with White patients. Due to the small number of Black physicians, especially Black oncologists,[43] about 80% of Black patients' clinical interactions are racially discordant (Black patients, non-Black physicians).[44] Patient-physician communication is often of poorer quality in racially discordant clinical interactions than racially concordant ones. Patients in racially discordant interactions tend to ask fewer questions[25] and are less likely to participate in decision making;[45] whereas physicians tend to be less patient-centered,[46,47] more verbally dominant,[47] more contentious,[48] exhibit fewer rapport building nonverbal behaviors,[49]

and provide less information.[27] Physicians and patients show fewer expressions of positive affect[47] and relationship-building attempts.[29]

Patient and physician race-related attitudes and perceptions affect interaction outcomes via communication behaviors. Prior research, including our own, suggests that *race-related attitudes and perceptions* (e.g., physician implicit bias against Black people, patient suspicion of medical care Black people receive) affect communication in clinical interactions and perceptions physicians and patients have of each other during racially discordant clinical interactions.[31-33,37,38] For example, physicians with higher levels of implicit (nonconscious) bias against Black people are perceived as less patient-centered and less trustworthy by their Black patients than physicians with lower levels of implicit bias against Black people.[31,40,41,50] Our prior research suggests such perceptions and behaviors are associated with less positive patient expectations about recommended treatments.[51] We have also found that Black patients with higher levels of suspicion of medical care are less optimistic about outcomes of recommended treatments and are perceived by their physicians to be less educated.[52] This, in turn, is associated with less positive physician expectations about how their Black patients will do on a treatment protocol, such as their adherence and/or ability to tolerate treatment. Given that these attitudes and perceptions are not directly observable, the only possible way in which they can affect perceptions and expectations is through their influence on communication behaviors.

Relatively little is known about *how* race-related attitudes and perceptions are manifested in communication behaviors during oncology interactions, or the effects of communication on interaction outcomes. Our own and others' research has shown that non-Black physicians' nonconscious race-related attitudes (i.e., implicit racial bias) influence their communication with Black patients.[51,53,54] Studies of nonmedical interracial interactions find that implicit bias is more

likely to be expressed through less deliberate nonverbal communication (e.g., facial expressions, posture) than through more deliberate verbal communication (e.g., spoken words).[55-58] Black patients' communication may be driven more by explicit than implicit race-related attitudes and perceptions,[59] but its expression may also be subtle and involve less deliberate communication (e.g., nonverbal behaviors).[54] The behavioral channels through which these race-related attitudes and perceptions are expressed are not known, but nonverbal synchrony is a promising candidate as one of them.

Nonverbal synchrony is the coordination of physical movement that occurs between two individuals during an interaction.[60] The construct of synchrony was first introduced more than 50 years ago and has sparked many related areas of study.[61] Here, we consider nonverbal synchrony as a dynamic and jointly determined phenomenon, not focused on any particular behavior (e.g., posture, eye contact). Rather, we consider nonverbal synchrony as a form of behavioral matching between two individuals. This matching does not have to occur at the same time (as it would for two people dancing), but it must involve similar kinds of motion and exhibit some sort of coordinated back-and-forth between individuals.[62-64] As an example, an individual shaking his or her head while another individual waves his or her hand would exhibit nonverbal synchrony but they are not mirroring one another nor are they perfectly in time.[63]

Considerable prior laboratory-based research shows that nonverbal synchrony is often nonconscious, unintentional, and effortless.[65-67] However, nonverbal synchrony can be predicted by pre-interaction attitudes[68] and has post-interaction consequences.[69] People synchronize more with others with whom they have positive relationships,[70] those with whom they want to develop positive relationships,[71] and others whom they trust.[68] In a recent experimental laboratory-based study, individuals with higher implicit bias favoring their own race synchronized more with an

avatar of their own race than with an avatar of a different race.[72] In terms of nonverbal synchrony's role as a predictor, nonverbal synchrony reflects more subsequent positive affect and liking,[69] perceptions of similarity, closeness, rapport with the interaction partner, and collaborative problem solving.[68,73-75] More relevant to clinical communication, nonverbal synchrony has been found to positively influence therapeutic processes,[76] cooperation,[77] obedience,[74] and memory for information provided by the interaction partner.[78,79]

To summarize, current evidence indicates that Black patients and non-Black physicians have negative reactions to each other's race-related attitudes and perceptions. Also, evidence indicates that these attitudes and perceptions are subtly manifested in communication. Little is known, however, about the channels through which these attitudes and perceptions are communicated. Because nonverbal synchrony is subtle, unintentional, automatic, and affect-laden, it may likely serve as a behavioral marker of race-related attitudes and perceptions. Here we describe the protocol for a study that will help fill this gap in understanding by examining the role of nonverbal synchrony in racially concordant and racially discordant oncology interactions. The study was designed to achieve the following *aims* and *hypotheses,* which are based on the research reviewed:

Aim 1: Assess and compare nonverbal synchrony between physicians and patients in racially concordant and racially discordant oncology interactions.

Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in racially discordant oncology interactions.

Aim 2: Determine the influence of nonverbal synchrony on physician communication style (e.g., level of patient-centeredness) and patient and physician affect in racially concordant and racially discordant oncology interactions.

Hypothesis 2: Nonverbal synchrony will positively influence physician patient-centered communication, patient and physician affect, and relational rapport in racially concordant and racially discordant clinical interactions.

Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially discordant oncology interactions.

Hypothesis 3: In racially discordant oncology interactions, nonverbal synchrony will significantly negatively covary with patient post-interaction distress and positively covary with 1) patient post-interaction perceptions of physicians' patient-centered communication and treatment expectations; 2) physicians' post-interaction perceptions of patient personal characteristics (e.g., understanding of treatment options) and their responses to treatment (e.g., willingness to follow treatment regimen), and 3) observers' ratings of physician patient-centered communication, patient and physician affect, and relational rapport.

Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction race-related attitudes and perceptions of the patient and physicians (e.g. physician implicit bias; patient suspicion).

Aim 4: Develop and test a mediational model that links physician and patient race-related attitudes and perceptions to nonverbal synchrony and, in turn, outcomes of racially discordant oncology interactions.

Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-interaction race-related attitudes and perceptions and post-interaction perceptions of the patients and physicians.

## METHODS AND ANALYSIS

**Overview of proposed study**. Our goals are to: 1) compare the extent to which physicians and patients synchronize their behavior in racially concordant and racially discordant oncology interactions; 2) compare the associations between nonverbal synchrony and self-report and observational measures of patient and physician affect and physicians' patient-centered communication in racially concordant and racially discordant oncology interactions; 3) investigate how race-related attitudes and perceptions (e.g., physician implicit bias, patient suspicion) affect nonverbal synchrony in racially discordant oncology interactions; 4) investigate how nonverbal synchrony affects the outcomes of racially discordant clinical interactions; and 5) test the conceptual model in Figure 1, which predicts that race-related attitudes and perceptions will be associated with patient and physician perceptions and treatment-related outcomes of racially discordant oncology interactions, through their influence on nonverbal synchrony. To achieve these goals, we will conduct a secondary analysis of data from two studies conducted by members of our study team. This secondary analysis was officially funded in September 2017. Thus, it is ongoing and will be completed by August 2019. **Study One,** which was funded by the National Cancer Institute (NCI), was conducted at two NCI-designated comprehensive cancer centers between April 2002 and March 2006 (R01CA75003),[80] was an investigation of how patient-oncologist communication influences patients' decision making about treatment including clinical trials. **Study Two** (also funded by the NCI)**,** was conducted at one of the **Study One** NCI-designated centers plus another large urban cancer clinic in the same city between April 2012 and December 2014**. Study Two** investigated associations between communication and outcomes during racially discordant oncology interactions (U54CA153606-04). [81] Only patients and oncologists from these studies who agreed on their consent forms to allow their

video-recorded and self-reported data to be used in secondary analyses will be used in the current study. Comparisons of groups did not find any socio-demographic or attitudinal differences between patients/oncologists who did and did not agree to be in secondary analyses.

**Data Sources.**

*Participants, Procedures, and Measures in Study One.* Patients from **Study One** who are in the current study include 163 self-identified White (92 male; 71 female) patients who were meeting with a White medical oncologist for the first time to discuss treatment for their cancer. Upon consent, which occurred immediately prior to meeting their oncologist, patients completed a survey assessing their sociodemographic characteristics. Oncologists were 22 White male medical oncologists (no female oncologists participated in **Study One**) who saw at least one participating patient ($M$ = 7.4 $SD$ = 7.0). Upon consent, oncologists completed a demographic survey. Exam rooms were equipped with unobtrusive digital audio and video recording devices. Studies have demonstrated the nonreactance to the recording process,[82] and enhanced validity compared to audio recording alone.[83]

*Participants, Procedures, and Measures in Study Two.* Patients from **Study Two** who are in the current study include 68 Black female patients who were meeting with a non-Black medical oncologist for the time to discuss treatment for their cancer. While patients were recruited for **Study Two** irrespective of sex, only 6 of the patients who enrolled were males. A meaningful statistical comparison on the variables of interest by patient sex cannot be conducted with so few male participants. Thus, we are excluding them from further analyses. Upon consent, patients provided sociodemographic information and completed measures of suspicion of medical care Black patients receive[34] and trust in medical institutions.[84] Oncologists were 16 (7 females; 9 males; 8 White; 6 Asian/Pacific Islander; 2 Arab/Middle Eastern) medical oncologists who saw

at least one participating patient ($M$ = 5.2, $SD$ = 6.4). Upon consent, oncologists completed a demographic survey and the Implicit Association Test, which assesses implicit racial bias against Black people.[85] Just as in **Study One**, exam rooms in **Study Two** were equipped with unobtrusive digital audio and video recording devices.

In **Study Two**, oncologists were consented upon enrollment, and the video-recorded clinical interactions took place within two weeks after patients consented. Immediately after the interactions, patients completed measures of distress,[86] perception of the physicians' patient-centered communication,[87] and expectations about recommended treatment. Also, immediately after interactions, oncologists completed measures of perceptions of the patient and how well the patient would do in treatment. One week later, patients reported their level of trust in their oncologist[84] in a telephone survey. Trained observers later observed and rated video-recorded interactions to assess physicians' patient-centered communication.[48] To do this, coders applied a global scale of physicians' patient-centered communication which assessed physicians' informativeness (e.g., "the doctor thoroughly explained everything to the patient"); supportiveness (e.g., "the doctor made the patient feel completely at ease during the consultation"); and partnership building (e.g., "the doctor encouraged the patient to express concerns and worries").[48] At least two observers rated physicians' patient-centered communication (three observers rated 15% of interactions to ensure continued reliability); inter-rater reliability was acceptable (intra-class correlation coefficient = .57-.74, $p$'s<.05). Each physician's patient-centered communication score was the average of observer ratings.

Five one-minute video slices were created from each of the recordings from the two studies (N = 340 slices) by dividing each video recording into five equal segments and selecting the first minute from each segment.[55,88-90] The slices were observed and rated by naïve observers

who had no training other than instructions to provide their ratings for patient and physician affect (e.g. warm/friendly) and relational rapport (e.g. attentive). The use of naïve observers is consistent with this type of methodology.[55,88]

**Hypotheses and Data Analysis.**

**Aim 1: Assess and compare nonverbal synchrony between physicians and patients in racially concordant and racially discordant oncology interactions.** We will achieve this aim by first matching video recordings from **Study One** and **Study Two** on patient and physician sex and other sociodemographics. Although our focus is on racial concordance/discordance, prior research suggests that patient and physician sex affects communication in medical interactions.[91-95] However, as described above, matching on sex is constrained by the distributions in the original recordings. Thus, from **Study One,** we will use 71 White female patients and 92 White male patients who interacted with White male physicians. From **Study Two,** we will use the 34 Black female patient/non-Black male physician dyads and 34 Black female patient/non-Black female physician dyads. Thus, within race concordant and race discordant interactions we will examine the effects of sex concordance and discordance. We acknowledge that this is not a full factorial design, but it will permit us to examine the influence of race concordance/discordance on nonverbal synchrony and, also partially examine whether the influence of race on nonverbal synchrony is moderated by patient and physician sex. To minimize any other differences between Black patients and White patients, we will also do block matching of patients from **Study One** with patients from **Study Two** on characteristics that might affect nonverbal communication (e.g., age, type of cancer). We expect this matching will reduce the number of patients available from **Study One** by 20-30% percent, but sufficient cases will be available for

well-powered analyses of racial concordance/discordance. We will then further the equivalence of patients with advanced methods of propensity scoring.[96-98]

We will assess nonverbal synchrony in all matched interactions using customized Motion Energy Analysis (http://psync.ch/?p=9)[76,99] software to obtain synchrony scores for each interaction. Figure 2 is a screenshot of the Motion Energy Analysis software. Motion Energy Analysis is an objective automated method that continuously monitors the amount of movement occurring in pre-defined regions of interest.[62,76,100] Motion Energy Analysis captures frame-by-frame movement and provides quantification of change in movement in the "regions of interest". In this study, we consider each individual as one "region of interest," allowing us to capture full body movement. Motion Energy Analysis uses pixel-differencing methods to measure total amount of movement. We will quantify nonverbal synchrony by deriving scores using windowed cross-correlation matrices to obtain synchrony scores for each interaction.[101] Nonverbal synchrony tends to ebb and flow during conversations.[91] Windowed cross-correlation accounts for the possibility of changing synchronization by comparing small sections of time at different time lags. By looking at multiple smaller sections at multiple different lags, windowed cross-correlation is able to estimate synchronization between systems which do not have a constant lag. Figure 3 is windowed cross-correlation output displayed as a heat map with warmer colors representing strong positive correlations between the two individuals' behavior (e.g., positive nonverbal synchrony) and cooler colors representing strong negative correlations (e.g., negative nonverbal synchrony). These synchrony scores are dyadic attributes that represent amounts and relationships of synchronous movement within dyads. Once we have obtained these scores, we will compare (a) effects of race concordance versus discordance on nonverbal synchrony and (b) effects of sex concordance versus discordance on nonverbal synchrony, and (c) determine the

relative impact of race concordance/discordance versus sex concordance/discordance on nonverbal synchrony.

*Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in racially discordant oncology interactions*. To obtain time-varying synchrony scores, we will block each interaction into five equal segments and obtain synchrony scores for each segment using Motion Energy Analysis. This procedure also allows us to adjust for patients and physicians moving outside of the regions of interest set at the beginning of each segment and maximizes the likelihood that we capture all patient and physician movement. For example, this strategy will help us capture continuous movement even if a patient or physician gets up from a seated position and walks outside of the pre-determined region of interest. To model changes in dynamic and overall levels of synchrony, we will use structural equation modeling (SEM) methods, latent differential equations (LDE), and multi-level modeling (MLM) methods. LDE is a special case of SEM that allows for estimation of parameters of a proposed underlying dynamical system. LDE models contain parameters pertaining to the dynamics of a given system (e.g., "eta" and "zeta" parameters of a latent harmonic oscillator model). We will use multi-group SEM modeling to test for differences in these parameters between racially concordant and racially discordant interactions. By using a likelihood ratio test comparing two models where 1) these dynamic parameters are free to vary and 2) where these parameters are constrained to be equal across models, we will be able to determine if the motion dynamics differ between racially concordant and racially discordant interactions. Using a three-level HLM model with time segments (level 1) nested within patient (level 2), and patient nested within physician (level 3), we will model changes in nonverbal synchrony based on a categorical variable modeling either racially concordant or racially discordant interactions. Assuming 168 dyads, an alpha of .05, a

correlation coefficient of .1, and a linear time effect, we have a power of .8 to detect an effect size of .50.

**Aim 2: Determine the influence of nonverbal synchrony on physician communication and patient and physician affect in racially concordant and racially discordant oncology interactions.** We will first collect the same observational measures for **Study One** as in **Study Two**, including physician patient-centered communication and patient and physician affect, and rapport. Trained research assistants will rate each of the racially concordant interactions on physicians' patient-centered communication.[48] Next, we will create thin slices of the interactions from **Study One** and naïve observers will rate the slices using the same measures of physician-patient affect and rapport as in **Study Two**. Then we will use the synchrony scores from Aim 1 to compare the relationship between nonverbal synchrony and patient-physician affect and rapport in racially concordant and discordant interactions.

*Hypothesis 2: Nonverbal synchrony will influence physician patient-centered communication, patient and physician affect, and relational rapport in racially concordant and racially discordant clinical interactions.* We will use MLM and multi-group SEM to create a mediation model where nonverbal synchrony will predict level-2 (patient) and level-3 (physician) outcomes. Assuming 168 dyads, an alpha of .05, and a correlation coefficient of .1, we have power of .8 to detect an effect size of .48.

**Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially discordant oncology interactions.** We will achieve this aim using the synchrony scores from the racially discordant interactions in **Study Two**. We will examine the relationships between nonverbal synchrony and 1) interaction outcomes collected in the parent study including: patient satisfaction, distress, perception of physicians' patient-centered communication, and treatment

expectations, and physician perceptions of the patient (e.g., willingness to follow treatment regimen), and 2) pre-interaction physician and patient race-related attitudes and perceptions (e.g., implicit bias; suspicion), also collected in the parent study.

*Hypothesis 3: In the racially discordant oncology interactions, nonverbal synchrony will significantly negatively covary with patient post-interaction distress and positively covary with 1) patient post-interaction perceptions of physicians' patient-centered communication and treatment expectations; 2) physicians' post-interaction perceptions of patient personal characteristics (e.g., understanding of treatment options) and their responses to treatment (e.g., willingness to follow treatment regimen); and 3) observers' ratings of physician patient-centered communication, patient and physician affect, and relational rapport.* Using LDE, we will model dynamic parameter values of the fluctuations in nonverbal synchrony over the course of each interaction. These values will then be used as first-level predictors in an MLM model. The second-level predictors for this model will be values associated with physician and patient post-interaction perceptions of the interaction and of each other. Assuming 68 dyads, an alpha of .05, and a correlation coefficient of .1, we have a power of .9 to detect an effect size of .56.

*Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction race-related attitudes and perceptions of the patient and physicians (e.g. physician implicit bias, patient suspicion).* We will create a three-level MLM. We will model synchrony assessed over five time segments nested within each patient and each patient nested within physician. Each patient-physician dyad will have its own average synchrony score.

**Aim 4: Develop and test a mediational model that links physician and patient race-related attitudes and perceptions to nonverbal synchrony and, in turn, outcomes of race-related discordant oncology interactions.**

*Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-interaction race-related attitudes and perceptions and post-interaction perceptions of the patients and physicians*. To examine the proposed mediations in a multilevel context, we will utilize multi-level SEM, as described by Preacher and colleagues.[102,103] These models address potential conflated estimates of mediated effects that can arise when using multi-level data. Time segments will be nested within each patient and each patient will be nested within physician, with synchrony varying at each time point. We will use a single mediation model to assess how physician and patient race-related attitudes and perceptions influence interaction outcomes via their influence on nonverbal synchrony.

**Patient and Public Involvement.**

Cancer survivors were heavily involved with both **Study One** and **Study Two**. Investigators had extensive conversations with survivors about their experiences as patients and survivors, which helped guide the research questions, measured outcomes, and design of both studies.

Patients were not directly involved with developing the research questions and outcomes for this secondary analysis. However, this work extends naturally from the considerable previous work we have done focused on understanding and improving patient-oncologist communication for all patients, with special attention to patients more vulnerable to cancer treatment and mortality disparities. This secondary analysis will investigate another important aspect of patient-physician communication that our patient and physician partners have agreed needs research attention.

Recruitment to both **Study One** and **Study Two** was done by the investigators and their research and clinic staff. As PI, Dr. Hamel will disseminate results from this investigation

through the Karmanos Cancer Institutes' Department of Community Outreach and Education, which has regularly scheduled meetings with cancer survivors, caretakers, and community stakeholders.

## ETHICS AND DISSEMINATION

Studies one, two, and the current study are all IRB-approved. Only patients and physicians from the previous studies who provided their consent for secondary analyses of their data were included in the current study. The nature of the data makes it unlikely we will encounter ethical or safety issues.

We will submit our ongoing findings to relevant communication, social psychology, and oncology conferences. Similarly, we plan to submit the final manuscripts to high-impact communication, social psychology, and oncology peer-reviewed journals.

## LIMITATIONS

Although this secondary analysis is innovative in its focus and methods, it is not without limitations. First, this study takes advantage of existing datasets, but the video-recorded and self-report data were not collected with the current hypotheses in mind. Second, the data are not evenly distributed by sex and race. As is often the case with medical research involving actual patients, the distributions of study patient characteristics are constrained by the distributions of patient demographic and medical characteristics of the patients that are treated at the participating hospitals. This reality precludes us from fully examining all combinations of race and sex. However, there are advantages to the fact that this research is conducted in a real-world, rather than a laboratory setting; also, we are able to account for some variability in our models by treating certain factors (e.g., cancer type) as random effects. Last, although given a design that is adequately powered to make both between- and within-subject comparisons, it is still possible

we may find no significant findings regarding nonverbal synchrony. Of course, this finding would be interesting in and of itself and would direct research attention to other avenues of investigation.

**FIGURE LEGEND**

Figure 1: Conceptual Model

Figure 2: Motion Energy Analysis Software

Figure 3: Window Cross Correlation Output

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**Authors' Statement:**

LMH: Principal Investigator, involved in all aspects of conceptualization and study design.

RM: Research Assistant, involved in the study design and responsible for design and implementation of statistical anlayses.

TLA: Co-Investigator, involved in all aspects of conceptualization and study design.

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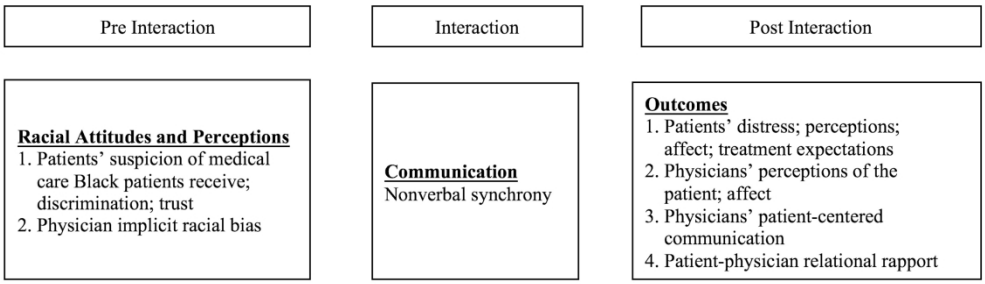


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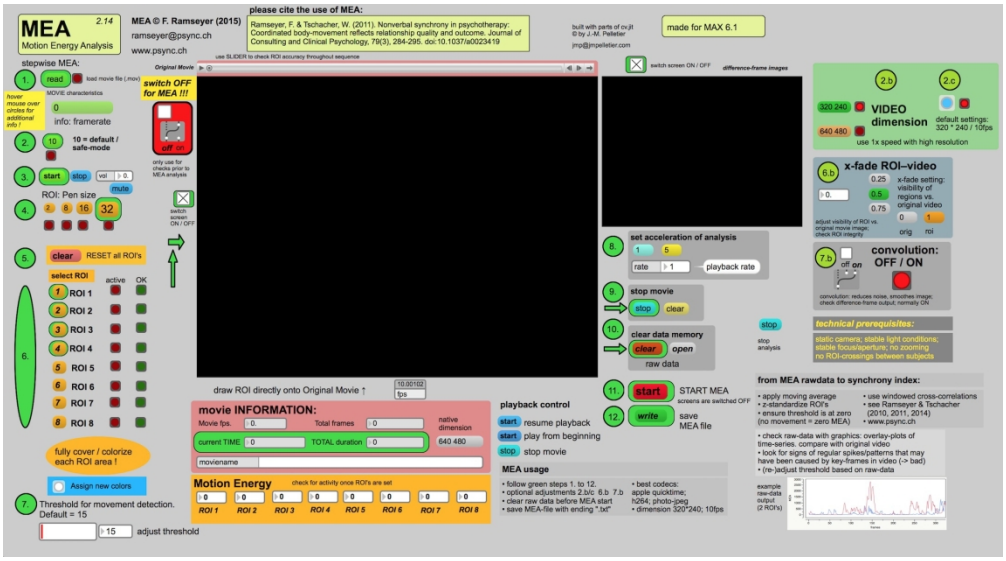


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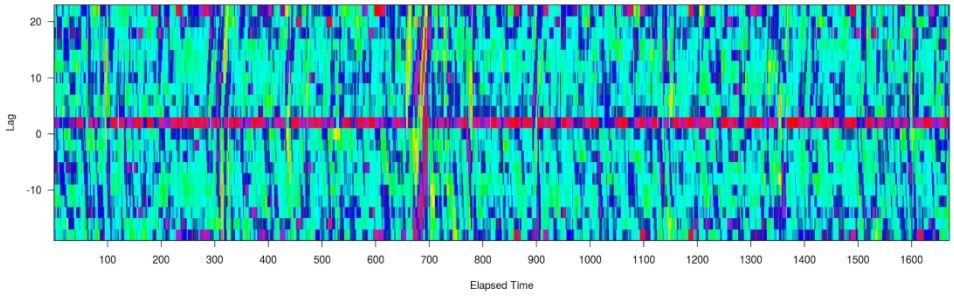


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# Nonverbal synchrony as a behavioral marker of patient and physician race-related attitudes and a predictor of outcomes in oncology interactions: Protocol for a secondary analysis of video-recorded cancer treatment discussions

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## Abstract

**Introduction:** Racial disparities in cancer treatment contribute to racial disparities in mortality rates. The quality of patient-physician communication during clinical interactions with Black patients and non-Black physicians (racially discordant) is poorer than communication quality in with White patients (racially concordant). Patient and physician race-related attitudes affect the quality of this communication. These attitudes are likely expressed through subtle nonverbal behaviors, but prior research has not examined these behaviors. Nonverbal synchrony, the coordination of physical movement, reflects the pre-interaction attitudes of participants in interactions *and* predicts their post-interaction perceptions of and affect toward one another. In this study, peer reviewed and funded by the National Institute of Minority Health and Health Disparities (R21MD011766), we will investigate nonverbal synchrony in racially concordant and discordant interactions to better understand racial disparities in clinical communication.

**Methods and analysis:** This secondary analysis includes racially concordant (n=163) and racially discordant (n=68) video-recorded oncology interactions, patient and oncologist self-reported race-related attitudes, perceptions of the interaction; and observer ratings of physician patient-centered communication and patient and physician affect and rapport. In Aim 1, we will assess and compare nonverbal synchrony between physicians and patients in racially concordant and discordant interactions. In Aim 2, we will determine the influence of nonverbal synchrony on patient and physician affect and communication. In Aim 3, we will examine possible causes (i.e., race-related attitudes) and consequences (i.e., negative perceptions) of nonverbal synchrony in racially discordant interactions. In Aim 4, we will develop and test a mediational model linking physician and patient race-related attitudes to nonverbal synchrony and, in turn, interaction outcomes.

**Ethics and dissemination**: The parent and current studies were approved by the Wayne State University Institutional Review Board. Since only archival data will be used, ethical or safety risks are low. We will disseminate our findings to relevant conferences and journals.


**Key Word: Nonverbal Synchrony; Disparities; Cancer; Racial Discordance; Race-related Attitudes**

**Strengths and limitations of this study:**

- This study explores nonverbal synchrony, a channel of communication that has not been previously examined in medical interactions.
- This study utilizes video-recorded cancer treatment discussions of Black and White patients with cancer, recorded with state-of-art recording equipment.
- This study utilizes automated behavioral coding software, which introduces less error than traditional methods using human coders.
- This study takes advantage of existing datasets, but the video-recorded and self-report data were not collected with the current hypotheses in mind.
- The data are not evenly distributed by sex and race.

## INTRODUCTION

Racial disparities in cancer mortality and treatment are well documented. In the United States, deaths due to cancer are approximately 20% higher for Black patients than for White patients.[1] This mortality disparity remains even after controlling for stage at diagnosis, disease aggressiveness, obesity, comorbidities, physician access, insurance status, and referrals.[2-6] Importantly, this disparity is greatest for the most treatable cancers.[7] This strongly suggests treatment disparities may contribute to mortality disparities.[8-14] For example, Black patients with cancer are less likely to receive chemotherapy for leukemia, breast, lung, and colorectal cancers. If they do receive treatment, it is more likely to be delayed or not adherent to the treatment guidelines set by the National Comprehensive Cancer Network.[2,8,15-23] Multiple causes of these treatment disparities exist including tumor biology, socioeconomic status, environment, and access to care.[6] However, research clearly shows that even when these factors are controlled, racial disparities in treatment remain. We focus on two other contributors to racial disparities in cancer treatments: 1) poor patient-physician communication during oncology interactions,[24-30] and 2) race-related attitudes and perceptions of physicians and patients.[31-42] We are investigating these factors because they account for unique variance in racial treatment disparities.

Black patients experience poorer quality communication during oncology interactions compared to similar interactions with White patients. Due to the small number of Black physicians, especially Black oncologists,[43] about 80% of Black patients' clinical interactions are racially discordant (Black patients, non-Black physicians).[44] Patient-physician communication is often of poorer quality in racially discordant clinical interactions than racially concordant ones. Patients in racially discordant interactions tend to ask fewer questions[25] and are less likely to participate in decision making;[45] whereas physicians tend to be less patient-centered,[46,47] more

verbally dominant,[47] more contentious,[48] exhibit fewer rapport building nonverbal behaviors,[49] and provide less information.[27] Physicians and patients show fewer expressions of positive affect[47] and relationship-building attempts.[29]

Patient and physician race-related attitudes and perceptions affect interaction outcomes via communication behaviors. Prior research, including our own, suggests that *race-related attitudes and perceptions* (e.g., physician implicit bias against Black people, patient suspicion of medical care Black people receive) affect communication in clinical interactions and perceptions physicians and patients have of each other during racially discordant clinical interactions.[31-33,37,38] For example, physicians with higher levels of implicit (unconscious) bias against Black people are perceived as less patient-centered and less trustworthy by their Black patients than physicians with lower levels of implicit bias against Black people.[31,40,41,50] Our prior research suggests such perceptions and behaviors are associated with less positive patient expectations about recommended treatments.[51] We have also found that Black patients with higher levels of suspicion of medical care are less optimistic about outcomes of recommended treatments and are perceived by their physicians to be less educated.[52] This, in turn, is associated with less positive physician expectations about how their Black patients will do on a treatment protocol, such as their adherence and/or ability to tolerate treatment. Given that these attitudes and perceptions are not directly observable, the only possible way in which they can affect perceptions and expectations is through their influence on communication behaviors.

Relatively little is known about *how* race-related attitudes and perceptions are manifested in communication behaviors during oncology interactions, or the effects of communication on interaction outcomes. Our own and others' research has shown that non-Black physicians' unconscious race-related attitudes (i.e., implicit racial bias) influence their communication with

Black patients.[51,53,54] Studies of nonmedical interracial interactions find that implicit bias is more likely to be expressed through less deliberate nonverbal communication (e.g., facial expressions, posture) than through more deliberate verbal communication (e.g., spoken words).[55-58] Black patients' communication may be driven more by explicit than implicit race-related attitudes and perceptions,[59] but its expression may also be subtle and involve less deliberate communication (e.g., nonverbal behaviors).[54] The behavioral channels through which these race-related attitudes and perceptions are expressed are not known, but nonverbal synchrony is a promising candidate as one of them.

Nonverbal synchrony is the coordination of physical movement that occurs between two individuals during an interaction.[60] The construct of synchrony was first introduced more than 50 years ago and has sparked many related areas of study.[61] Here, we consider nonverbal synchrony as a dynamic and jointly determined phenomenon, not focused on any particular behavior (e.g., posture, eye contact). Rather, we consider nonverbal synchrony as a form of behavioral matching between two individuals. This matching does not have to occur at the same time (as it would for two people dancing), but it must involve similar kinds of motion and exhibit some sort of coordinated back-and-forth between individuals.[62-64] As an example, an individual shaking his or her head while another individual waves his or her hand would exhibit nonverbal synchrony but they are not mirroring one another nor are they perfectly in time.[63]

Considerable prior laboratory-based research shows that nonverbal synchrony is often unconscious, unintentional, and effortless.[65-67] However, nonverbal synchrony can be predicted by pre-interaction attitudes[68] and has post-interaction consequences.[69] People synchronize more with others with whom they have positive relationships,[70] those with whom they want to develop positive relationships,[71] and others whom they trust.[68] In a recent experimental laboratory-based

study, individuals with higher implicit bias favoring their own race synchronized more with an avatar of their own race than with an avatar of a different race.[72] In terms of nonverbal synchrony's role as a predictor, nonverbal synchrony reflects more subsequent positive affect and liking,[69] perceptions of similarity, closeness, rapport with the interaction partner, and collaborative problem solving.[68,73-75] More relevant to clinical communication, nonverbal synchrony has been found to positively influence therapeutic processes,[76] cooperation,[77] obedience,[74] and memory for information provided by the interaction partner.[78,79] It is because of this previous research that we will investigate general nonverbal synchrony in this study, rather than, for example, vocal synchrony or synchrony of more precise behaviors such as eye gaze.

To summarize, current evidence indicates that Black patients and non-Black physicians have negative reactions to each other's race-related attitudes and perceptions. Also, evidence indicates that these attitudes and perceptions are subtly manifested in communication. Little is known, however, about the channels through which these attitudes and perceptions are communicated. Because nonverbal synchrony is subtle, unintentional, automatic, and affect-laden, it may likely serve as a behavioral marker of race-related attitudes and perceptions. Here we describe the protocol for a study that will help fill this gap in understanding by examining the role of nonverbal synchrony in racially concordant and racially discordant oncology interactions. The study was designed to achieve the following *aims* and *hypotheses,* which are based on the research reviewed:

Aim 1: Assess and compare nonverbal synchrony between physicians and patients in racially concordant and racially discordant oncology interactions.

Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in racially discordant oncology interactions.

Aim 2: Determine the influence of nonverbal synchrony on physician communication style (e.g., level of patient-centeredness) and patient and physician affect in racially concordant and racially discordant oncology interactions.

Hypothesis 2: Nonverbal synchrony will positively influence physician patient-centered communication, patient and physician affect, and relational rapport in racially concordant and racially discordant clinical interactions.

Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially discordant oncology interactions.

Hypothesis 3: In racially discordant oncology interactions, nonverbal synchrony will significantly negatively covary with patient post-interaction distress and positively covary with 1) patient post-interaction perceptions of physicians' patient-centered communication and treatment expectations; 2) physicians' post-interaction perceptions of patient personal characteristics (e.g., understanding of treatment options) and their responses to treatment (e.g., willingness to follow treatment regimen), and 3) observers' ratings of physician patient-centered communication, patient and physician affect, and relational rapport.

Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction race-related attitudes and perceptions of the patient and physicians (e.g. physician implicit bias; patient suspicion).

Aim 4: Develop and test a mediational model that links physician and patient race-related attitudes and perceptions to nonverbal synchrony and, in turn, outcomes of racially discordant oncology interactions.

Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-interaction race-related attitudes and perceptions and post-interaction perceptions of the patients and physicians.

## METHODS AND ANALYSIS

**Overview of proposed study**. Our goals are to: 1) compare the extent to which physicians and patients synchronize their behavior in racially concordant and racially discordant oncology interactions; 2) compare the associations between nonverbal synchrony and self-report and observational measures of patient and physician affect and physicians' patient-centered communication in racially concordant and racially discordant oncology interactions; 3) investigate how race-related attitudes and perceptions (e.g., physician implicit bias, patient suspicion) affect nonverbal synchrony in racially discordant oncology interactions; 4) investigate how nonverbal synchrony affects the outcomes of racially discordant clinical interactions; and 5) test the conceptual model in Figure 1, which predicts that race-related attitudes and perceptions will be associated with patient and physician perceptions and treatment-related outcomes of racially discordant oncology interactions, through their influence on nonverbal synchrony. To achieve these goals, we will conduct a secondary analysis of data from two studies conducted by members of our study team. This secondary analysis was officially funded in September 2017. Thus, it is ongoing and will be completed by August 2019. **Study One,** which was funded by the National Cancer Institute (NCI), was conducted at two NCI-designated comprehensive cancer centers between April 2002 and March 2006 (R01CA75003),[80] was an investigation of how patient-oncologist communication influences patients' decision making about treatment including clinical trials. **Study Two** (also funded by the NCI)**,** was conducted at one of the **Study**

**One** NCI-designated centers plus another large urban cancer clinic in the same city between April 2012 and December 2014**. Study Two** investigated associations between communication and outcomes during racially discordant oncology interactions (U54CA153606-04). [81] Only patients and oncologists from these studies who agreed on their consent forms to allow their video-recorded and self-reported data to be used in secondary analyses will be used in the current study. Comparisons of groups did not find any socio-demographic or attitudinal differences between patients/oncologists who did and did not agree to be in secondary analyses.

**Data Sources.**

*Participants, Procedures, and Measures in Study One.* Patients from **Study One** who are in the current study include 163 self-identified White (92 male; 71 female) patients who were meeting with a White medical oncologist for the first time to discuss treatment for their cancer. Upon consent, which occurred immediately prior to meeting their oncologist, patients completed a survey assessing their sociodemographic characteristics. Oncologists were 22 White male medical oncologists (no female oncologists participated in **Study One**) who saw at least one participating patient ($M$ = 7.4 $SD$ = 7.0). Upon consent, oncologists completed a demographic survey. Exam rooms were equipped with unobtrusive digital audio and video recording devices. Studies have demonstrated the nonreactance to the recording process,[82] and enhanced validity compared to audio recording alone.[83]

*Participants, Procedures, and Measures in Study Two.* Patients from **Study Two** who are in the current study include 68 Black female patients who were meeting with a non-Black medical oncologist for the time to discuss treatment for their cancer. While patients were recruited for **Study Two** irrespective of sex, only 6 of the patients who enrolled were males. A meaningful statistical comparison on the variables of interest by patient sex cannot be conducted with so few

male participants. Thus, we are excluding them from further analyses. Upon consent, patients provided sociodemographic information and completed measures of suspicion of medical care Black patients receive[34] and trust in medical institutions.[84] There were 16 medical oncologists (7 females; 9 males; 8 White; 6 Asian/Pacific Islander; 2 Arab/Middle Eastern) who saw at least one participating patient ($M$ = 5.2, $SD$ = 6.4). Upon consent, oncologists completed a demographic survey and the Implicit Association Test, which assesses implicit racial bias against Black people.[85] Just as in **Study One**, exam rooms in **Study Two** were equipped with unobtrusive digital audio and video recording devices.

In **Study Two**, oncologists were consented upon enrollment, and the video-recorded clinical interactions took place within two weeks after patients consented. Immediately after the interactions, patients completed measures of distress,[86] perception of the physicians' patient-centered communication,[87] and expectations about recommended treatment. Also, immediately after interactions, oncologists completed measures of perceptions of the patient and how well the patient would do in treatment. One week later, patients reported their level of trust in their oncologist[84] in a telephone survey. Trained observers later observed and rated video-recorded interactions to assess physicians' patient-centered communication.[48] To do this, coders applied a global scale of physicians' patient-centered communication which assessed physicians' informativeness (e.g., "the doctor thoroughly explained everything to the patient"); supportiveness (e.g., "the doctor made the patient feel completely at ease during the consultation"); and partnership building (e.g., "the doctor encouraged the patient to express concerns and worries").[48] At least two observers rated physicians' patient-centered communication (three observers rated 15% of interactions to ensure continued reliability); inter-

rater reliability was acceptable (intra-class correlation coefficient = .57-.74, *p*'s<.05). Each physician's patient-centered communication score was the average of observer ratings.

Five one-minute video slices were created from each of the recordings from the two studies (N = 340 slices) by dividing each video recording into five equal segments and selecting the first minute from each segment.[55,88-90] The slices were observed and rated by naïve observers who had no training other than instructions to provide their ratings for patient and physician affect (e.g. warm/friendly) and relational rapport (e.g. attentive). The use of naïve observers is consistent with this type of methodology.[55,88]

**Hypotheses and Data Analysis.**

**Aim 1: Assess and compare nonverbal synchrony between physicians and patients in racially concordant and racially discordant oncology interactions.** We will achieve this aim by first matching video recordings from **Study One** and **Study Two** on patient and physician sex and other sociodemographics. Although our focus is on racial concordance/discordance, prior research suggests that patient and physician sex affects communication in medical interactions.[91-95] However, as described above, matching on sex is constrained by the distributions in the original recordings. Thus, from **Study One,** we will use 71 White female patients and 92 White male patients who interacted with White male physicians. From **Study Two,** we will use the 34 Black female patient/non-Black male physician dyads and 34 Black female patient/non-Black female physician dyads. Thus, within race concordant and race discordant interactions we will examine the effects of sex concordance and discordance. We acknowledge that this is not a full factorial design, but it will permit us to examine the influence of race concordance/discordance on nonverbal synchrony and, also partially examine whether the influence of race on nonverbal synchrony is moderated by patient and physician sex. To minimize any other differences

between Black patients and White patients, we will also do block matching of patients from **Study One** with patients from **Study Two** on characteristics that might affect nonverbal communication (e.g., age, type of cancer). We expect this matching will reduce the number of patients available from **Study One** by 20-30% percent, but sufficient cases will be available for well-powered analyses of racial concordance/discordance. We will then further the equivalence of patients with advanced methods of propensity scoring.[96-98]

We will assess nonverbal synchrony in all matched interactions using customized Motion Energy Analysis (http://psync.ch/?p=9)[76,99] software to obtain synchrony scores for each interaction. Figure 2 is a screenshot of the Motion Energy Analysis software. Motion Energy Analysis is an objective automated method that continuously monitors the amount of movement occurring in pre-defined regions of interest.[62,76,100] Motion Energy Analysis captures frame-by-frame movement and provides quantification of change in movement in the "regions of interest". In this study, we consider each individual as one "region of interest," allowing us to capture full body movement. Motion Energy Analysis uses pixel-differencing methods to measure total amount of movement. We will quantify nonverbal synchrony by deriving scores using windowed cross-correlation matrices to obtain synchrony scores for each interaction.[101] Nonverbal synchrony tends to ebb and flow during conversations.[91] Windowed cross-correlation accounts for the possibility of changing synchronization by comparing small sections of time at different time lags. By looking at multiple smaller sections at multiple different lags, windowed cross-correlation is able to estimate synchronization between systems which do not have a constant lag. Figure 3 is windowed cross-correlation output displayed as a heat map with warmer colors representing strong positive correlations between the two individuals' behavior (e.g., positive nonverbal synchrony) and cooler colors representing strong negative correlations (e.g., negative

nonverbal synchrony). These synchrony scores are dyadic attributes that represent amounts and relationships of synchronous movement within dyads. Once we have obtained these scores, we will compare (a) effects of race concordance versus discordance on nonverbal synchrony and (b) effects of sex concordance versus discordance on nonverbal synchrony, and (c) determine the relative impact of race concordance/discordance versus sex concordance/discordance on nonverbal synchrony.

*Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in racially discordant oncology interactions*. To obtain time-varying synchrony scores, we will block each interaction into five equal segments and obtain synchrony scores for each segment using Motion Energy Analysis. This procedure also allows us to adjust for patients and physicians moving outside of the regions of interest set at the beginning of each segment and maximizes the likelihood that we capture all patient and physician movement. For example, this strategy will help us capture continuous movement even if a patient or physician gets up from a seated position and walks outside of the pre-determined region of interest. To model changes in dynamic and overall levels of synchrony, we will use structural equation modeling (SEM) methods, latent differential equations (LDE), and multi-level modeling (MLM) methods. LDE is a special case of SEM that allows for estimation of parameters of a proposed underlying dynamical system. LDE models contain parameters pertaining to the dynamics of a given system (e.g., "eta" and "zeta" parameters of a latent harmonic oscillator model). We will use multi-group SEM modeling to test for differences in these parameters between racially concordant and racially discordant interactions. By using a likelihood ratio test comparing two models where 1) these dynamic parameters are free to vary and 2) where these parameters are constrained to be equal across models, we will be able to determine if the motion dynamics differ between racially

concordant and racially discordant interactions. Using a three-level HLM model with time segments (level 1) nested within patient (level 2), and patient nested within physician (level 3), we will model changes in nonverbal synchrony based on a categorical variable modeling either racially concordant or racially discordant interactions. Assuming 168 dyads, an alpha of .05, a correlation coefficient of .1, and a linear time effect, we have a power of .8 to detect an effect size of .50.

**Aim 2: Determine the influence of nonverbal synchrony on physician communication and patient and physician affect in racially concordant and racially discordant oncology interactions.** We will first collect the same observational measures for **Study One** as in **Study Two**, including physician patient-centered communication and patient and physician affect, and rapport. Trained research assistants will rate each of the racially concordant interactions on physicians' patient-centered communication.[48] Next, we will create thin slices of the interactions from **Study One** and naïve observers will rate the slices using the same measures of physician-patient affect and rapport as in **Study Two**. Then we will use the synchrony scores from Aim 1 to compare the relationship between nonverbal synchrony and patient-physician affect and rapport in racially concordant and discordant interactions.

*Hypothesis 2: Nonverbal synchrony will influence physician patient-centered communication, patient and physician affect, and relational rapport in racially concordant and racially discordant clinical interactions.* We will use MLM and multi-group SEM to create a mediation model where nonverbal synchrony will predict level-2 (patient) and level-3 (physician) outcomes. Assuming 168 dyads, an alpha of .05, and a correlation coefficient of .1, we have power of .8 to detect an effect size of .48.

**Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially discordant oncology interactions.** We will achieve this aim using the synchrony scores from the racially discordant interactions in **Study Two**. We will examine the relationships between nonverbal synchrony and 1) interaction outcomes collected in the parent study including: patient satisfaction, distress, perception of physicians' patient-centered communication, and treatment expectations, and physician perceptions of the patient (e.g., willingness to follow treatment regimen), and 2) pre-interaction physician and patient race-related attitudes and perceptions (e.g., implicit bias; suspicion), also collected in the parent study.

*Hypothesis 3: In the racially discordant oncology interactions, nonverbal synchrony will significantly negatively covary with patient post-interaction distress and positively covary with 1) patient post-interaction perceptions of physicians' patient-centered communication and treatment expectations; 2) physicians' post-interaction perceptions of patient personal characteristics (e.g., understanding of treatment options) and their responses to treatment (e.g., willingness to follow treatment regimen); and 3) observers' ratings of physician patient-centered communication, patient and physician affect, and relational rapport.* Using LDE, we will model dynamic parameter values of the fluctuations in nonverbal synchrony over the course of each interaction. These values will then be used as first-level predictors in an MLM model. The second-level predictors for this model will be values associated with physician and patient post-interaction perceptions of the interaction and of each other. Assuming 68 dyads, an alpha of .05, and a correlation coefficient of .1, we have a power of .9 to detect an effect size of .56.

*Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction race-related attitudes and perceptions of the patient and physicians (e.g. physician implicit bias, patient suspicion).* We will create a three-level MLM. We will model synchrony assessed over five time

segments nested within each patient and each patient nested within physician. Each patient-physician dyad will have its own average synchrony score.

**Aim 4: Develop and test a mediational model that links physician and patient race-related attitudes and perceptions to nonverbal synchrony and, in turn, outcomes of race-related discordant oncology interactions.**

*Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-interaction race-related attitudes and perceptions and post-interaction perceptions of the patients and physicians*. To examine the proposed mediations in a multilevel context, we will utilize multi-level SEM, as described by Preacher and colleagues.[102,103] These models address potential conflated estimates of mediated effects that can arise when using multi-level data. Time segments will be nested within each patient and each patient will be nested within physician, with synchrony varying at each time point. We will use a single mediation model to assess how physician and patient race-related attitudes and perceptions influence interaction outcomes via their influence on nonverbal synchrony.

**Patient and Public Involvement.**

Cancer survivors were heavily involved with both **Study One** and **Study Two**. Investigators had extensive conversations with survivors about their experiences as patients and survivors, which helped guide the research questions, measured outcomes, and design of both studies.

Patients were not directly involved with developing the research questions and outcomes for this secondary analysis. However, this work extends naturally from the considerable previous work we have done focused on understanding and improving patient-oncologist communication for all patients, with special attention to patients more vulnerable to cancer treatment and

mortality disparities. This secondary analysis will investigate another important aspect of patient-physician communication that our patient and physician partners have agreed needs research attention.

Recruitment to both **Study One** and **Study Two** was done by the investigators and their research and clinic staff. As PI, Dr. Hamel will disseminate results from this investigation through the Karmanos Cancer Institutes' Department of Community Outreach and Education, which has regularly scheduled meetings with cancer survivors, caretakers, and community stakeholders.

## ETHICS AND DISSEMINATION

Studies one (069003B3D), two (125211B3E), and the current study (044716B3E) are all approved by the Wayne State University Institutional Review Board. Only patients and physicians from the previous studies who provided their consent for secondary analyses of their data were included in the current study. The nature of the data makes it unlikely we will encounter ethical or safety issues.

We will submit our ongoing findings to relevant communication, social psychology, and oncology conferences. Similarly, we plan to submit the final manuscripts to high-impact communication, social psychology, and oncology peer-reviewed journals.

## STRENGTHS AND LIMITATIONS

This secondary analysis is innovative in its focus and method. This study explores nonverbal synchrony, a channel of communication that has not been previously examined in medical interactions. It takes advantage of existing datasets, which include video-recorded cancer treatment discussions of Black and White patients with cancer, recorded with state-of-art

recording equipment. It also applies automated behavioral coding software, thus introducing less error than traditional methods using human coders.

However, this study is not without limitations. First, this study takes advantage of existing datasets, but the video-recorded and self-report data were not collected with the current hypotheses in mind. Second, the data are not evenly distributed by sex and race. As is often the case with medical research involving actual patients, the distributions of study patient characteristics are constrained by the distributions of patient demographic and medical characteristics of the patients that are treated at the participating hospitals. This reality precludes us from fully examining all combinations of race and sex. However, there are advantages to the fact that this research is conducted in a real-world, rather than a laboratory setting; also, we are able to account for some variability in our models by treating certain factors (e.g., cancer type) as random effects. Last, although given a design that is adequately powered to make both between- and within-subject comparisons, it is still possible we may find no significant findings regarding nonverbal synchrony. Of course, this finding would be interesting in and of itself and would direct research attention to other avenues of investigation.

**FIGURE LEGEND**

Figure 1: Conceptual Model

Figure 2: Motion Energy Analysis Software

Figure 3: Window Cross Correlation Output

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**Authors' Statement:**

LMH: Principal Investigator, involved in all aspects of conceptualization and study design.

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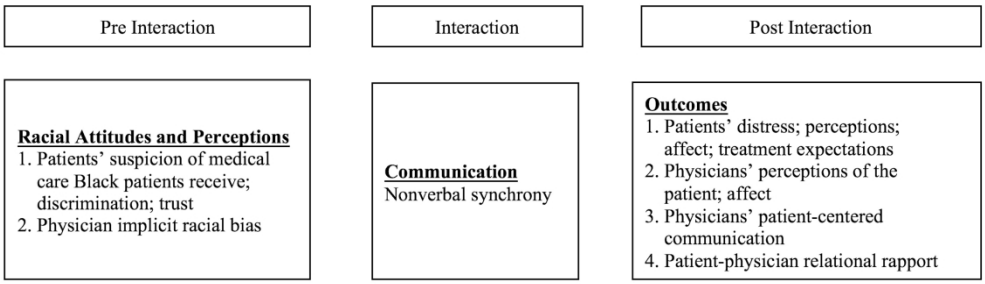


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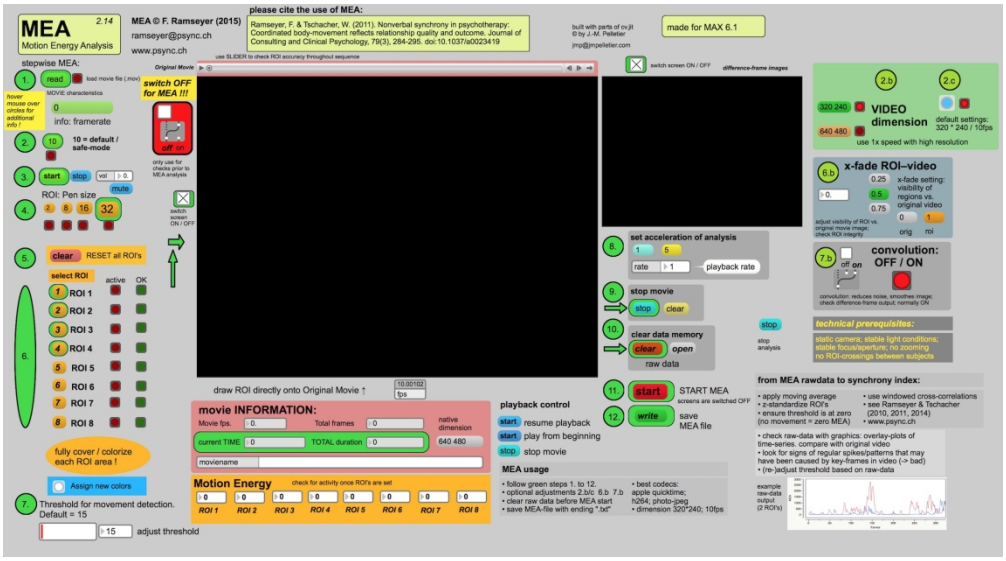


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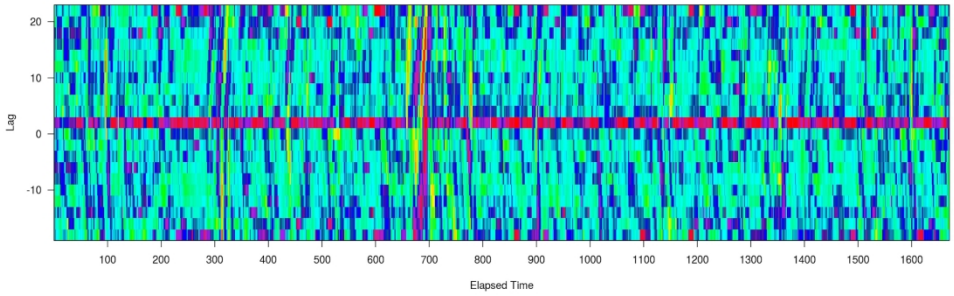


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