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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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3 **Nonverbal synchrony as a behavioral marker of patient and physician race-related**
4 **attitudes and a predictor of outcomes of oncology interactions: A cross-sectional study**
5 **of video-recorded cancer treatment discussions**
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For peer review only

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 questions²⁵ 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 affect⁴⁷ and relationship-building attempts.²⁹

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

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38 Relatively little is known about *how* race-related attitudes are manifested in communication
39 behaviors during oncology interactions or the effects of communication on interaction outcomes.
40 Our own and others' research has shown that non-Black physicians' nonconscious race-related
41 attitudes (i.e., implicit racial bias) influence their communication with Black patients.^{51,54-56}
42 Studies of nonmedical interracial interactions find that implicit bias is more likely to be
43 expressed through less deliberate nonverbal communication (e.g., facial expressions, posture)
44 than through more deliberate verbal communication (i.e., spoken words).⁵⁷⁻⁶⁰ Black patients'
45 communication may be driven more by explicit than implicit race-related attitudes,⁶¹ but its
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3 expression also seems to be subtle and involve less deliberate communication (e.g., nonverbal
4 behaviors). The behavioral channels through which these race-related attitudes are expressed are
5
6 not known, but nonverbal synchrony is a promising candidate as one of them.
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10 Considerable prior research shows that nonverbal synchrony, or the coordination of
11 physical movement that occurs between individuals during an interaction,⁶² is often
12 nonconscious, unintentional, and effortless.⁶³⁻⁶⁵ However, nonverbal synchrony can be predicted
13 by pre-interaction attitudes⁶⁶ and has post-interaction consequences.⁶⁷ People synchronize more
14 with others with whom they have positive relationships,⁶⁸ those with whom they want to develop
15 positive relationships,⁶⁹ and others whom they trust.⁶⁶ In a recent experimental lab-based study,
16 individuals with higher implicit bias synchronized more with an avatar of their own race than
17 with an avatar of a different race.⁷⁰ In terms of nonverbal synchrony's role as a predictor,
18 nonverbal synchrony reflects more subsequent positive affect and liking,⁶⁷ perceptions of
19 similarity, closeness, and rapport with the interaction partner.^{66,71,72} More relevant to clinical
20 communication, nonverbal synchrony has been found to positively influence therapeutic
21 processes,⁷³ cooperation,⁷⁴ obedience,⁷² and memory for information provided by the interaction
22 partner.^{75,76}
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40 In sum: we know that Black patients and non-Black physicians react to each other's race-
41 related attitudes. We know that these attitudes are likely subtly manifested in communication.
42 Little is known, however, about the channels through which these attitudes are communicated.
43 Because nonverbal synchrony is subtle, unintentional, automatic and affect-laden, it may likely
44 serve as a behavioral marker of race-related attitudes. The current study will help fill this gap in
45 understanding by examining the role of nonverbal synchrony in racially concordant and racially
46 discordant oncology interactions.
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3 The study was designed to achieve the following *aims* and *hypotheses*:
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5 Aim 1: Assess and compare nonverbal synchrony between physicians and patients in
6 racially concordant and racially discordant oncology interactions.
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8 Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in
9 racially discordant oncology interactions.
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11 Aim 2: Determine the influence of nonverbal synchrony on physician communication
12 style (e.g., patient centered) and patient and physician affect in racially concordant and
13 racially discordant oncology interactions.
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15 Hypothesis 2: Nonverbal synchrony will influence physician patient-centered
16 communication, patient and physician affect, and relational rapport in racially
17 concordant and racially discordant clinical interactions.
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19 Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially
20 discordant oncology interactions.
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22 Hypothesis 3: In the racially discordant oncology interactions, nonverbal
23 synchrony will significantly negatively covary with patient post-interaction
24 distress and positively covary with 1) patient post-interaction perceptions of
25 physicians' patient-centered communication and treatment expectations, 2)
26 physicians' post-interaction perceptions of patient personal characteristics (e.g.,
27 understanding of treatment options), and their responses to treatment (e.g.,
28 willingness to follow treatment regimen), and 3) observers' ratings of physician
29 patient-centered communication, patient and physician affect, and relational
30 rapport.
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3 Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction
4 race-related attitudes of the patient and physicians (e.g. physician implicit bias;
5 patient suspicion).
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10 Aim 4: Develop and test a mediational model that links physician and patient race-related
11 attitudes to nonverbal synchrony and, in turn, outcomes of racially discordant oncology
12 interactions.
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17 Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-
18 interaction race-related attitudes and post-interaction perceptions of the patients
19 and physicians.
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25 **METHODS AND ANALYSIS**

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27 **Overview of proposed study.** Our goals are to: 1) compare the extent to which physicians and
28 patients synchronize their behavior in racially concordant and racially discordant oncology
29 interactions, 2) compare the associations between nonverbal synchrony and self-report and
30 observational measures of patient and physician affect and physicians' patient-centered
31 communication in racially concordant and racially discordant oncology interactions, 3)
32 investigate how race-related attitudes (e.g., physician implicit bias; patient suspicion) affect
33 nonverbal synchrony in racially discordant oncology interactions, 4) investigate how nonverbal
34 synchrony affects the outcomes of racially discordant clinical interactions, and 5) test the
35 conceptual model in Figure 1, which predicts that race-related attitudes will be associated with
36 patient and physician perceptions and treatment-related outcomes of racially discordant oncology
37 interactions, through their influence on nonverbal synchrony. To achieve these goals, we will
38 conduct a secondary analysis of data from two studies conducted by members of our study team.
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54 **Study One**, conducted at two NCI-designated comprehensive cancer centers (R01CA75003),⁷⁷
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3 was an investigation of how patient-oncologist communication influences patients' decision
4 making about treatment including clinical trials. **Study Two**, conducted at one of the **Study One**
5 NCI-designated centers plus another large urban cancer clinic, investigated associations between
6 communication and outcomes during racially discordant oncology interactions (U54CA153606-
7 04).^{78 78} Patients and oncologists from both studies who agreed to secondary analyses of their
8 recordings will be used in the current study. Comparisons of groups did not find any socio-
9 demographic or attitudinal differences between patients/oncologists who did and did not agree to
10 be in secondary analyses.

21 **Data Sources.**

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

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

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3 *Measures:* At baseline, patients provided sociodemographic information and completed measures
4 of suspicion of medical care Black patients receive³⁴ and trust in physicians.⁸¹ At baseline,
5 oncologists completed a demographic survey and completed the Implicit Association Test (IAT),
6 which assesses implicit racial bias against Black people.⁸² The video-recorded clinical interactions
7 interactions took place several weeks later. Immediately after the interactions, patients completed
8 measures of distress, perception of the physicians' patient-centered communication, and
9 expectations about recommended treatment. Also, immediately after interactions, oncologists
10 completed measures of perceptions of the patient and how well the patient would do in treatment.
11 One week later, patients reported their level of trust in their oncologist in a telephone survey.
12 Trained observers later observed and rated video recorded interactions to assess physicians'
13 patient-centered communication.⁴⁸ At least two observers rated physician communication; inter-
14 rater reliability was acceptable (ICC = .57-.74, p 's<.05). Each physician's patient centeredness
15 score was the average of multiple observer ratings.
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33 Five one-minute video slices were created from each of the recordings (N = 340 slices)
34 by dividing each video recording into five equal segments and selecting the first minute from
35 each segment.^{57,83-85} The slices were rated by naïve observers for patient and physician affect
36 (e.g. warm/friendly,) and relational rapport (e.g. attentive).
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44 **Hypotheses and Data Analysis.**

45 **Aim 1: Assess and compare nonverbal synchrony between physicians and patients in**
46 **racially concordant and racially discordant oncology interactions.** We will achieve this aim
47 by first matching video recordings from **Study One** and **Study Two** on patient and physician sex
48 and other sociodemographics. Although our focus is on racial concordance/discordance, prior
49 research suggests that patient and physician sex affects communication in medical interactions.⁸⁶⁻
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3⁹⁰ However, as described above, matching on sex is constrained by the distributions in the
4 original recordings. Thus, from **Study One**, we will use 71 White female patients and 92 White
5 male patients who interacted with male non-Black physicians. From **Study Two**, we will use the
6 34 Black female patient-non-Black male physician dyads and 34 Black female patient-non-Black
7 female physician interactions. Thus, within race concordant and race discordant interactions we
8 will examine the effects of sex concordance and discordance. We acknowledge that this is not a
9 full factorial design, but it will permit us to examine the influence of race
10 concordance/discordance on nonverbal synchrony and, also partially examine whether the
11 influence of race on nonverbal synchrony is moderated by patient and physician sex. To
12 minimize any other differences between Black and White patients, we will also do block
13 matching of patients from **Study One** with patients from **Study Two** on characteristics that
14 might affect nonverbal communication (e.g., age, type of cancer). We expect this matching will
15 reduce the number of patients available from **Study One** by 20-30% percent, but sufficient cases
16 will be available for well-powered analyses of racial concordance/discordance. We will then
17 further the equivalence of patients with advanced methods of propensity scoring.⁹¹⁻⁹³

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

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3 correlation (WCC) matrices to obtain a synchrony index for each interaction.⁹⁷ Nonverbal
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5 synchronization of interaction tends to ebb and flow during conversations and thus is
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7 nonstationary.⁹¹ WCC accounts for the possibility of nonstationary synchronization when
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9 comparing two time series by comparing small sections of the time series at a time at different
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11 time lags. Figure 3 is WCC output displayed as a heat map with warmer colors representing
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13 strong positive correlations between the two individuals' behavior and cooler colors representing
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15 strong negative correlations. These scores are dyadic attributes that represent amounts and
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17 relationships of synchronous movement within dyads. Then we will compare (a) effects of race
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19 concordance versus discordance on nonverbal synchrony and (b) effects of sex concordance
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21 versus discordance on nonverbal synchrony, and (c) determine the relative impact of race
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23 concordance/discordance versus sex concordance/discordance on nonverbal synchrony.
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28 *Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in racially*
29 *discordant oncology interactions.* To obtain time varying synchrony scores, we will block each
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31 interaction into five equal segments and obtain synchrony indices for each segment using MEA.
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33 This procedure also allows us to adjust for patients and physicians moving outside of the regions
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35 of interest set at the beginning of each segment and maximizes the likelihood that we capture all
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37 patient and physician movement. To model changes in dynamic and overall levels of synchrony,
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39 we will use structural equation modeling (SEM) methods, latent differential equations (LDE),
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41 and multi-level modeling (MLM) methods. LDE is a special case of SEM that allows for
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43 estimation of parameters of a proposed underlying dynamical system. LDE models contain
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45 parameters pertaining to the dynamics of a given system (e.g., “eta” and “zeta” parameters of a
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47 latent harmonic oscillator model). We will use multi-group SEM modeling to test for differences
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49 in these parameters between racially concordant and racially discordant interactions. By using a
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3 likelihood ratio test comparing two models where 1) these dynamic parameters are free to vary
4 and 2) where these parameters are constrained to be equal across models, we will be able to
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6 determine if the motion dynamics differ between racially concordant and racially discordant
7 interactions. Using a three-level HLM model with time segments (level-1) nested within patient
8 (level-2), and patient nested within physician (level-3), we will model changes in nonverbal
9 synchrony based on a categorical variable modeling either racially concordant or racially
10 discordant interactions. Assuming 168 dyads, an alpha of .05, a correlation coefficient of .1, and
11 a linear time effect, we have a power of .8 to detect a medium effect size of .50.
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21 **Aim 2: Determine the influence of nonverbal synchrony on physician communication and**
22 **patient and physician affect in racially concordant and racially discordant oncology**
23 **interactions.** We will first collect the same observational measures for **Study One** as in **Study**
24 **Two.** Trained research assistants will rate each of the racially concordant interactions on
25 physicians' patient-centered communication.⁴⁸ Next, we will create thin slices of the interactions
26 from **Study One** – naïve observers will rate the slices using the same measures of physician-
27 patient affect and rapport as in **Study Two.** Then we will use the synchrony indices from Aim 1
28 to compare the relationship between nonverbal synchrony and patient-physician affect and
29 rapport in racially concordant and discordant interactions.
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42 *Hypothesis 2: Nonverbal synchrony will influence physician patient-centered communication,*
43 *patient and physician affect, and relational rapport in racially concordant and racially*
44 *discordant clinical interactions.* We will use MLM and multi-group SEM to create a mediation
45 model where nonverbal synchrony will predict level-2 (patient) and level-3 (physician)
46 outcomes. Assuming 168 dyads, an alpha of .05, and a correlation coefficient of .1, we have
47 power of .8 to detect an effect size of .48.
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3 **Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially**
4 **discordant oncology interactions.** We will achieve this aim using the synchrony indices from
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6 the racially discordant interactions in **Study Two**. We will examine the relationships between
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8 nonverbal synchrony and: 1) interaction outcomes including: patient satisfaction, distress,
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10 perception of physicians' patient-centered communication, and treatment expectations, and
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12 physician perceptions of the patient (e.g., willingness to follow treatment regimen), and 2) pre-
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14 interaction physician and patient race-related attitudes (e.g., implicit bias; suspicion).
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19 *Hypothesis 3: In the racially discordant oncology interactions, nonverbal synchrony will*
20 *significantly negatively covary with patient post-interaction distress and positively covary with*
21 *1) patient post-interaction perceptions of physicians' patient-centered communication and*
22 *treatment expectations, 2) physicians' post-interaction perceptions of patient personal*
23 *characteristics (e.g., understanding of treatment options), and their responses to treatment (e.g.,*
24 *willingness to follow treatment regimen), and 3) observers' ratings of physician patient-centered*
25 *communication, patient and physician affect, and relational rapport.* Using LDE, we will model
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27 dynamic parameter values of the fluctuations in nonverbal synchrony over the course of each
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29 interaction. These values will then be used as first level predictors in a MLM model. The second
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31 level predictors for this model will be values associated with physician and patient post
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33 interaction perceptions of the interaction and of each other. Assuming 68 dyads, an alpha of .05,
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35 and a correlation coefficient of .1, we have a power of .9 to detect an effect size of .56.
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46 *Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction race-related*
47 *attitudes of the patient and physicians (e.g. physician implicit bias; patient suspicion).* We will
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49 create a three-level MLM. We will model synchrony assessed over five time segments nested
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3 within each patient and each patient nested within physician. Each patient-physician dyad will
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5 have its own average synchrony score.
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8 **Aim 4: Develop and test a mediational model that links physician and patient race-related**
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10 **attitudes to nonverbal synchrony and, in turn, outcomes of race-related discordant**
11 **oncology interactions.**
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15 *Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-interaction race-*
16 *related attitudes and post-interaction perceptions of the patients and physicians.* To examine the
17 proposed mediations in a multilevel context, we will utilize multi-level SEM, as described by
18 Preacher and colleagues.^{98,99} These models address potential conflated estimates of mediated
19 effects that can arise when using multi-level data. Time segments will be nested within each
20 patient and each patient will be nested within physician, with synchrony varying at each time
21 point. We will use a single mediation model to assess how physician and patient race-related
22 attitudes impact interaction outcomes via their impact on nonverbal synchrony.
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33 **ETHICS AND DISSEMINATION**

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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.

REFERENCES

1. Statistics National Center for Health Statistics. *Health, United States, 2015: with special feature on racial and ethnic health disparities*. Hyattsville, MD2016.
2. Murphy CC, Harlan LC, Warren JL, Geiger AM. Race and Insurance Differences in the Receipt of Adjuvant Chemotherapy Among Patients With Stage III Colon Cancer. *J Clin Oncol*. 2015;33(23):2530-2536.
3. Bach PB, Schrag D, Brawley OW, Galaznik A, Yakren S, Begg CB. Survival of blacks and whites after a cancer diagnosis. *JAMA*. 2002;287(16):2106-2113.
4. Greenwald HP, Polissar NL, Borgatta EF, McCorkle R, Goodman G. Social factors, treatment, and survival in early-stage non-small cell lung cancer. *Am J Public Health*. 1998;88(11):1681-1684.
5. Ramsey SD, Howlader N, Etzioni RD, Donato B. Chemotherapy use, outcomes, and costs for older persons with advanced non-small-cell lung cancer: evidence from surveillance, epidemiology and end results-Medicare. *J Clin Oncol*. 2004;22(24):4971-4978.
6. Smedley BD, Stith AY, Nelson AR. *Unequal treatment: confronting racial and ethnic disparities in health care*. . Institute of Medicine;2003.
7. Tehranifar P, Neugut AI, Phelan JC, et al. Medical advances and racial/ethnic disparities in cancer survival. *Cancer Epidemiol Biomarkers Prev*. 2009;18(10):2701-2708.
8. Patel MI, Ma Y, Mitchell B, Rhoads KF. How do differences in treatment impact racial and ethnic disparities in acute myeloid leukemia? *Cancer Epidemiol Biomarkers Prev*. 2015;24(2):344-349.
9. Ward E, Jemal A, Cokkinides V, et al. Cancer disparities by race/ethnicity and socioeconomic status. *CA Cancer J Clin*. 2004;54(2):78-93.
10. Ghafoor A, Jemal A, Ward E, Cokkinides V, Smith R, Thun M. Trends in breast cancer by race and ethnicity. *CA Cancer J Clin*. 2003;53(6):342-355.
11. Jemal A, Siegel R, Ward E, et al. Cancer statistics, 2006. *CA Cancer J Clin*. 2006;56(2):106-130.
12. Siegel R, Ma J, Zou Z, Jemal A. Cancer statistics, 2014. *CA Cancer J Clin*. 2014;64(1):9-29.
13. Hardy D, Liu CC, Xia R, et al. Racial disparities and treatment trends in a large cohort of elderly black and white patients with nonsmall cell lung cancer. *Cancer*. 2009;115(10):2199-2211.
14. Quality AfHRA. *2014 National Healthcare Quality and Disparities Report*. Rockville, MD. 2015.
15. Griggs JJ, Sorbero ME, Stark AT, Heining SE, Dick AW. Racial disparity in the dose and dose intensity of breast cancer adjuvant chemotherapy. *Breast Cancer Res Treat*. 2003;81(1):21-31.
16. Morris AM, Billingsley KG, Hayanga AJ, Matthews B, Baldwin LM, Birkmeyer JD. Residual treatment disparities after oncology referral for rectal cancer. *J Natl Cancer Inst*. 2008;100(10):738-744.
17. Berger M, Lund MJ, Brawley OW. Racial disparities in lung cancer. *Curr Probl Cancer*. 2007;31(3):202-210.

18. Daly B, Olopade OI. A perfect storm: How tumor biology, genomics, and health care delivery patterns collide to create a racial survival disparity in breast cancer and proposed interventions for change. *CA Cancer J Clin*. 2015;65(3):221-238.
19. Hayn MH, Orom H, Shavers VL, et al. Racial/ethnic differences in receipt of pelvic lymph node dissection among men with localized/regional prostate cancer. *Cancer*. 2011;117(20):4651-4658.
20. Penner LA, Eggly S, Griggs JJ, Underwood W, 3rd, Orom H, Albrecht TL. Life-Threatening Disparities: The Treatment of Black and White Cancer Patients. *J Soc Issues*. 2012;68(2).
21. Meghani SH, Kang Y, Chittams J, McMenamin E, Mao JJ, Fudin J. African Americans with cancer pain are more likely to receive an analgesic with toxic metabolite despite clinical risks: a mediation analysis study. *J Clin Oncol*. 2014;32(25):2773-2779.
22. Hassett MJ, Schymura MJ, Chen K, Boscoe FP, Gesten FC, Schrag D. Variation in breast cancer care quality in New York and California based on race/ethnicity and Medicaid enrollment. *Cancer*. 2015.
23. Phelan JC, Link BG. Is Racism a Fundamental Cause of Inequalities in Health? *Annual Review of Sociology, Vol 41*. 2015;41:311-330.
24. Jean-Pierre P, Fiscella K, Griggs J, et al. Race/ethnicity-based concerns over understanding cancer diagnosis and treatment plan. *J Natl Med Assoc*. 2010;102(3):184-189.
25. Eggly S, Harper FW, Penner LA, Gleason MJ, Foster T, Albrecht TL. Variation in question asking during cancer clinical interactions: a potential source of disparities in access to information. *Patient Educ Couns*. 2011;82(1):63-68.
26. Eggly S, Barton E, Winckles A, Penner LA, Albrecht TL. A disparity of words: racial differences in oncologist-patient communication about clinical trials. *Health Expect*. 2015;18(5):1316-1326.
27. Gordon HS, Street RL, Jr., Sharf BF, Soucek J. Racial differences in doctors' information-giving and patients' participation. *Cancer*. 2006;107(6):1313-1320.
28. Gordon HS, Street RL, Jr., Sharf BF, Kelly PA, Soucek J. Racial differences in trust and lung cancer patients' perceptions of physician communication. *J Clin Oncol*. 2006;24(6):904-909.
29. Siminoff LA, Graham GC, Gordon NH. Cancer communication patterns and the influence of patient characteristics: disparities in information-giving and affective behaviors. *Patient Educ Couns*. 2006;62(3):355-360.
30. Song L, Hamilton JB, Moore AD. Patient-healthcare provider communication: perspectives of African American cancer patients. *Health Psychol*. 2012;31(5):539-547.
31. Penner LA, Dovidio JF, West TV, et al. Aversive Racism and Medical Interactions with Black Patients: A Field Study. *J Exp Soc Psychol*. 2010;46(2):436-440.
32. Boulware LE, Cooper LA, Ratner LE, LaVeist TA, Powe NR. Race and trust in the health care system. *Public Health Rep*. 2003;118(4):358-365.
33. Nguyen GC, LaVeist TA, Harris ML, Datta LW, Bayless TM, Brant SR. Patient trust-in-physician and race are predictors of adherence to medical management in inflammatory bowel disease. *Inflamm Bowel Dis*. 2009;15(8):1233-1239.
34. Thompson HS, Valdimarsdottir HB, Winkel G, Jandorf L, Redd W. The Group-Based Medical Mistrust Scale: psychometric properties and association with breast cancer screening. *Prev Med*. 2004;38(2):209-218.

- 1
- 2
- 3 35. Bird ST, Bogart LM. Perceived race-based and socioeconomic status(SES)-based
- 4 discrimination in interactions with health care providers. *Ethn Dis*. 2001;11(3):554-563.
- 5 36. Bird ST, Bogart LM, Delahanty DL. Health-related correlates of perceived discrimination
- 6 in HIV care. *AIDS Patient Care STDS*. 2004;18(1):19-26.
- 7 37. O'Malley AS, Sheppard VB, Schwartz M, Mandelblatt J. The role of trust in use of
- 8 preventive services among low-income African-American women. *Prev Med*.
- 9 2004;38(6):777-785.
- 10 38. Green AR, Carney DR, Pallin DJ, et al. Implicit bias among physicians and its prediction
- 11 of thrombolysis decisions for black and white patients. *J Gen Intern Med*.
- 12 2007;22(9):1231-1238.
- 13 39. Hagiwara N, Penner LA, Gonzalez R, et al. Racial attitudes, physician-patient talk time
- 14 ratio, and adherence in racially discordant medical interactions. *Soc Sci Med*.
- 15 2013;87:123-131.
- 16 40. Cooper LA, Roter DL, Carson KA, et al. The associations of clinicians' implicit attitudes
- 17 about race with medical visit communication and patient ratings of interpersonal care. *Am*
- 18 *J Public Health*. 2012;102(5):979-987.
- 19 41. Blair IV, Steiner JF, Fairclough DL, et al. Clinicians' implicit ethnic/racial bias and
- 20 perceptions of care among Black and Latino patients. *Ann Fam Med*. 2013;11(1):43-52.
- 21 42. Hausmann LR, Myaskovsky L, Niyonkuru C, et al. Examining implicit bias of physicians
- 22 who care for individuals with spinal cord injury: A pilot study and future directions. *J*
- 23 *Spinal Cord Med*. 2015;38(1):102-110.
- 24 43. Hamel LM, Chapman R, Malloy M, et al. Critical Shortage of African American Medical
- 25 Oncologists in the United States. *J Clin Oncol*. 2015;33(32):3697-3700.
- 26 44. Kirkwood MK, Kosty MP, Bajorin DF, Bruinooge SS, Goldstein MA. Tracking the
- 27 workforce: the American Society of Clinical Oncology workforce information system. *J*
- 28 *Oncol Pract*. 2013;9(1):3-8.
- 29 45. Cooper-Patrick L, Gallo JJ, Gonzales JJ, et al. Race, gender, and partnership in the
- 30 patient-physician relationship. *JAMA*. 1999;282(6):583-589.
- 31 46. Cooper LA, Roter DL, Johnson RL, Ford DE, Steinwachs DM, Powe NR. Patient-
- 32 centered communication, ratings of care, and concordance of patient and physician race.
- 33 *Ann Intern Med*. 2003;139(11):907-915.
- 34 47. Johnson RL, Roter D, Powe NR, Cooper LA. Patient race/ethnicity and quality of patient-
- 35 physician communication during medical visits. *Am J Public Health*. 2004;94(12):2084-
- 36 2090.
- 37 48. Street RL, Jr., Gordon H, Haidet P. Physicians' communication and perceptions of
- 38 patients: is it how they look, how they talk, or is it just the doctor? *Soc Sci Med*.
- 39 2007;65(3):586-598.
- 40 49. Elliott AM, Alexander SC, Mescher CA, Mohan D, Barnato AE. Differences in
- 41 Physicians' Verbal and Nonverbal Communication With Black and White Patients at the
- 42 End of Life. *J Pain Symptom Manage*. 2016;51(1):1-8.
- 43 50. Penner LA, Gaertner S, Dovidio JF, et al. A social psychological approach to improving
- 44 the outcomes of racially discordant medical interactions. *J Gen Intern Med*.
- 45 2013;28(9):1143-1149.
- 46 51. Penner LA, Dovidio JF, Gonzalez R, et al. The Effects of Oncologist Implicit Racial Bias
- 47 in Racially Discordant Oncology Interactions. *J Clin Oncol*. 2016;34(24):2874-2880.
- 48
- 49
- 50
- 51
- 52
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- 54
- 55
- 56
- 57
- 58
- 59
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- 2
- 3 52. Penner L. The influence of race-related attitudes on healthcare: The Elephant in the
- 4 (Examination) room? . Division 9 Invited Address, Annual Meeting of the American
- 5 Psychological Association.; 2013; Honolulu, Hawaii.
- 6
- 7 53. Penner LA, Harper FW, Albrecht TL, Eggly S. The impact of Black patients' race-related
- 8 attitudes on the quality of racially discordant oncology interactions. Annual Meeting of
- 9 the Society of Behavioral Medicine; March, 2017; San Diego, CA.
- 10
- 11 54. Penner LA, Blair IV, Albrecht TL, Dovidio JF. Reducing Racial Health Care Disparities:
- 12 A Social Psychological Analysis. *Policy Insights Behav Brain Sci.* 2014;1(1):204-212.
- 13
- 14 55. Hamel LM. Racial attitudes and nonverbal convergence of patients and physicians in
- 15 oncology interactions. Invited Presentation, University of Rochester Medical School's
- 16 Cancer Control Research Group; 2016; Rochester, NY.
- 17
- 18 56. Hamel LM, Manning MA, Eggly S, Penner LA, Chapman R, Albrecht TL. Racial
- 19 attitudes and nonverbal convergence of patients and physicians in oncology interactions.
- 20 International Conference on Communication in Healthcare; 2016, September;
- 21 Heidelberg, Germany.
- 22
- 23 57. Richeson JA, Shelton JN. Brief report: Thin slices of racial bias. *Journal of Nonverbal*
- 24 *Behavior.* 2005;29(1):75-86.
- 25
- 26 58. Dovidio JF, Kawakami K, Gaertner SL. Implicit and explicit prejudice and interracial
- 27 interaction. *Journal of Personality and Social Psychology.* 2002;82(1):62-68.
- 28
- 29 59. Dovidio JF, Kawakami K, Johnson C, Johnson B, Howard A. On the nature of prejudice:
- 30 Automatic and controlled processes. *Journal of Experimental Social Psychology.*
- 31 1997;33(5):510-540.
- 32
- 33 60. Dovidio JF, LaFrance M. Race, ethnicity, and nonverbal behavior. . In: Hall JA, Knapp
- 34 M, eds. *Nonverbal communication.* The Hague, The Netherlands: DeGruyter-Mouton;
- 35 2013:671-696.
- 36
- 37 61. Penner LA, Hagiwara N, Eggly S, Gaertner SL, Albrecht TL, Dovidio JF. Racial
- 38 Healthcare Disparities: A Social Psychological Analysis. *Eur Rev Soc Psychol.*
- 39 2013;24(1):70-122.
- 40
- 41 62. Kimura M, Daibo I. Interactional synchrony in conversations about emotional episodes:
- 42 A measurement by "the between-participants pseudosynchrony experimental paradigm".
- 43 *Journal of Nonverbal Behavior.* 2006;30(3):115-126.
- 44
- 45 63. Chartrand TL, Lakin JL. The Antecedents and Consequences of Human Behavioral
- 46 Mimicry. *Annual Review of Psychology, Vol 64.* 2013;64:285-308.
- 47
- 48 64. White K, Argo JJ. When Imitation Doesn't Flatter: The Role of Consumer Distinctiveness
- 49 in Responses to Mimicry. *Journal of Consumer Research.* 2011;38(4):667-680.
- 50
- 51 65. Chartrand TL, Maddux WW, Lakin JL. Beyond the perception-behavior link: The
- 52 ubiquitous utility and motivational moderators of nonconscious mimicry. In: Hassin RR,
- 53 Uleman JS, Bargh JA, eds. *The New Unconscious:* Oxford University Press; 2005:334-
- 54 361.
- 55
- 56 66. Vacharkulksemsuk T, Fredrickson BL. Strangers in sync: Achieving embodied rapport
- 57 through shared movements. *Journal of Experimental Social Psychology.* 2012;48(1):399-
- 58 402.
- 59
- 60 67. Hove MJ, Risen JL. It's All in the Timing: Interpersonal Synchrony Increases Affiliation.
- 61 *Social Cognition.* 2009;27(6):949-960.

- 1
2
3 68. Miles LK, Griffiths JL, Richardson MJ, Macrae CN. Too late to coordinate: Contextual
4 influences on behavioral synchrony. *European Journal of Social Psychology*.
5 2010;40(1):52-60.
6
7 69. Miles LK, Lumsden J, Richardson MJ, Macrae CN. Do birds of a feather move together?
8 Group membership and behavioral synchrony. *Experimental Brain Research*.
9 2011;211(3-4):495-503.
10
11 70. Sacheli LM, Christensen A, Giese MA, et al. Prejudiced interactions: implicit racial bias
12 reduces predictive simulation during joint action with an out-group avatar. *Scientific*
13 *Reports*. 2015;5.
14
15 71. Paladino MP, Mazzurega M, Pavani F, Schubert TW. Synchronous Multisensory
16 Stimulation Blurs Self-Other Boundaries. *Psychological Science*. 2010;21(9):1202-1207.
17
18 72. Wiltermuth S. Synchrony and destructive obedience. *Social Influence*. 2012;7(2):78-89.
19
20 73. Ramseyer F, Tschacher W. Nonverbal Synchrony in Psychotherapy: Coordinated Body
21 Movement Reflects Relationship Quality and Outcome. *Journal of Consulting and*
22 *Clinical Psychology*. 2011;79(3):284-295.
23
24 74. Valdesolo P, Ouyang J, DeSteno D. The rhythm of joint action: Synchrony promotes
25 cooperative ability. *Journal of Experimental Social Psychology*. 2010;46(4):693-695.
26
27 75. Macrae CN, Duffy OK, Miles LK, Lawrence J. A case of hand waving: Action synchrony
28 and person perception. *Cognition*. 2008;109(1):152-156.
29
30 76. Miles LK, Nind LK, Henderson Z, Macrae CN. Moving memories: Behavioral synchrony
31 and memory for self and others. *Journal of Experimental Social Psychology*.
32 2010;46(2):457-460.
33
34 77. Albrecht TL, Eggly SS, Gleason ME, et al. Influence of clinical communication on
35 patients' decision making on participation in clinical trials. *J Clin Oncol*.
36 2008;26(16):2666-2673.
37
38 78. Eggly S, Hamel LM, Foster TS, et al. Randomized trial of a question prompt list to
39 increase patient active participation during interactions with black patients and their
40 oncologists. *Patient Educ Couns*. 2017;100(5):818-826.
41
42 79. Penner LA, Orom H, Albrecht TL, Franks MM, Foster TS, Ruckdeschel JC. Camera-
43 related behaviors during video recorded medical interactions. *Journal of Nonverbal*
44 *Behavior*. 2007;31(2):99-117.
45
46 80. Riddle DL, Albrecht TL, Coovert MD, et al. Differences in audiotaped versus videotaped
47 physician-patient interactions. *Journal of Nonverbal Behavior*. 2002;26(4):219-239.
48
49 81. Dugan E, Trachtenberg F, Hall MA. Development of abbreviated measures to assess
50 patient trust in a physician, a health insurer, and the medical profession. *BMC Health*
51 *Serv Res*. 2005;5:64.
52
53 82. Greenwald AG, Nosek BA, Banaji MR. Understanding and using the implicit association
54 test: I. An improved scoring algorithm. *J Pers Soc Psychol*. 2003;85(2):197-216.
55
56 83. Ambady N, Rosenthal R. Thin Slices of Expressive Behavior as Predictors of
57 Interpersonal Consequences - a Metaanalysis. *Psychological Bulletin*. 1992;111(2):256-
58 274.
59
60 84. Murphy NA. Using thin slices for behavioral coding. *Journal of Nonverbal Behavior*.
2005;29(4):235-246.
85. Roter DL, Hall JA, Blanch-Hartigan D, Larson S, Frankel RM. Slicing it thin: New
methods for brief sampling analysis using RIAS-coded medical dialogue. *Patient*
Education and Counseling. 2011;82(3):410-419.

- 1
2
3 86. Roter DL, Hall JA, Aoki Y. Physician gender effects in medical communication: a meta-
4 analytic review. *JAMA*. 2002;288(6):756-764.
5 87. Janssen SM, Lagro-Janssen AL. Physician's gender, communication style, patient
6 preferences and patient satisfaction in gynecology and obstetrics: a systematic review.
7 *Patient Educ Couns*. 2012;89(2):221-226.
8 88. Schieber AC, Delpierre C, Lepage B, et al. Do gender differences affect the doctor-
9 patient interaction during consultations in general practice? Results from the
10 INTERMEDE study. *Fam Pract*. 2014;31(6):706-713.
11 89. Inglehart MR. Interactions between patients and dental care providers: does gender
12 matter? *Dent Clin North Am*. 2013;57(2):357-370.
13 90. Bertakis KD, Azari R. Patient-centered care: the influence of patient and resident
14 physician gender and gender concordance in primary care. *J Womens Health (Larchmt)*.
15 2012;21(3):326-333.
16 91. Iacus SM KG, Porro G. . Causal inference without balance checking: Coarsened exact
17 matching. *Political Analysis* 2011;mpr013.
18 92. King GN, R. . Why propensity scores should not be used for matching. *Working Paper*.
19 2016.
20 93. Austin PC. An Introduction to Propensity Score Methods for Reducing the Effects of
21 Confounding in Observational Studies. *Multivariate Behav Res*. 2011;46(3):399-424.
22 94. *Motion Energy Analysis (MEA) [Computer software]*. [computer program]. Retrieved
23 from <http://www.psync.ch2016>.
24 95. Ramseyer F, Tschacher W. Nonverbal Synchrony or Random Coincidence? How to Tell
25 the Difference. *Development of Multimodal Interfaces: Active Listening and Synchrony*.
26 2010;5967:182-196.
27 96. Ramseyer F, Tschacher W. Nonverbal synchrony in psychotherapy: Coordinated
28 movement, the therapeutic relationship and outcome. *International Journal of*
29 *Psychology*. 2008;43(3-4):59-59.
30 97. Boker SM, Xu MQ, Rotondo JL, King K. Windowed cross-correlation and peak picking
31 for the analysis of variability in the association between behavioral time series.
32 *Psychological Methods*. 2002;7(3):338-355.
33 98. Preacher KJ, Zyphur MJ, Zhang Z. A General Multilevel SEM Framework for Assessing
34 Multilevel Mediation. *Psychological Methods*. 2010;15(3):209-233.
35 99. Preacher KJ, Zhang Z, Zyphur MJ. Alternative Methods for Assessing Mediation in
36 Multilevel Data: The Advantages of Multilevel SEM. *Structural Equation Modeling-a*
37 *Multidisciplinary Journal*. 2011;18(2):161-182.
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45 **Authors' Statement:**

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49 implementation of statistical analyses.
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51 TLA: Co-Investigator, involved in all aspects of conceptualization and study design.
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Figures

Figure 1: Conceptual Model

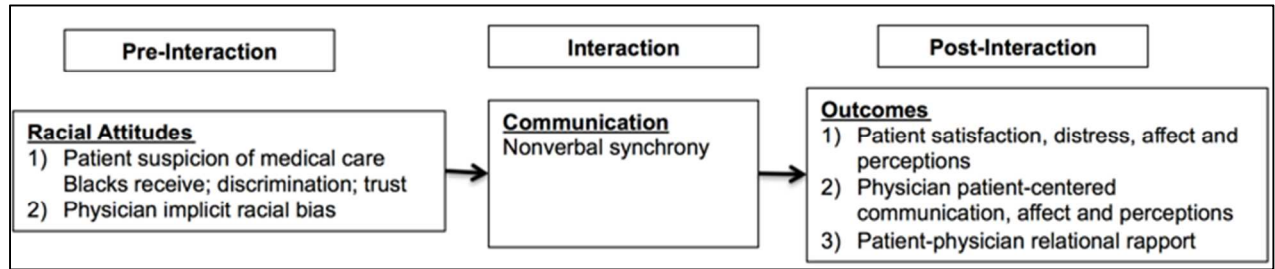


Figure 2: Motion Energy Analysis Software

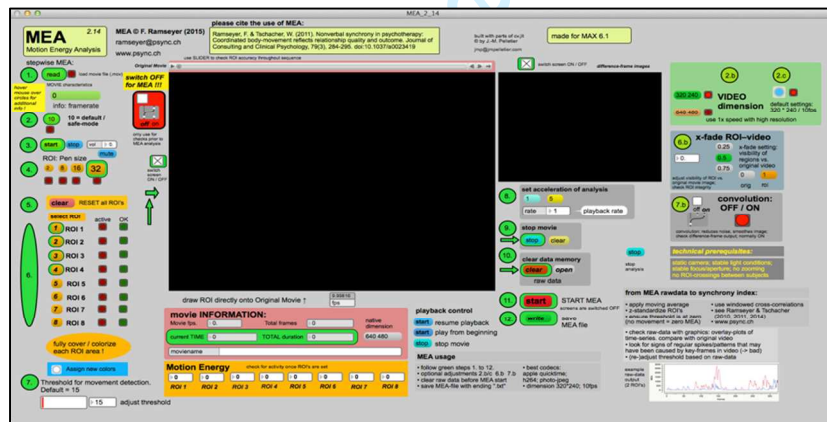
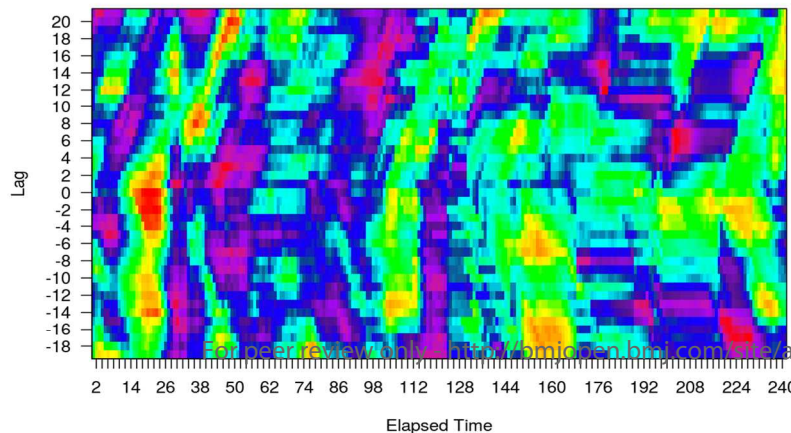


Figure 3: Window Cross Correlation Output



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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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3 **Nonverbal synchrony as a behavioral marker of patient and physician race-related**
4 **attitudes and a predictor of outcomes in oncology interactions:**
5 **Protocol for a secondary analysis of video-recorded cancer treatment discussions**
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For peer review only

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 questions²⁵ 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

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3 and provide less information.²⁷ Physicians and patients show fewer expressions of positive
4 affect⁴⁷ and relationship-building attempts.²⁹
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8 Patient and physician race-related attitudes and perceptions affect interaction outcomes via
9 communication behaviors. Prior research, including our own, suggests that *race-related attitudes*
10 *and perceptions* (e.g., physician implicit bias against Black people, patient suspicion of medical
11 care Black people receive) affect communication in clinical interactions and perceptions
12 physicians and patients have of each other during racially discordant clinical interactions.^{31-33,37,38}
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14 For example, physicians with higher levels of implicit (nonconscious) bias against Black people
15 are perceived as less patient-centered and less trustworthy by their Black patients than physicians
16 with lower levels of implicit bias against Black people.^{31,40,41,50} Our prior research suggests such
17 perceptions and behaviors are associated with less positive patient expectations about
18 recommended treatments.⁵¹ We have also found that Black patients with higher levels of
19 suspicion of medical care are less optimistic about outcomes of recommended treatments and are
20 perceived by their physicians to be less educated.⁵² This, in turn, is associated with less positive
21 physician expectations about how their Black patients will do on a treatment protocol, such as
22 their adherence and/or ability to tolerate treatment. Given that these attitudes and perceptions are
23 not directly observable, the only possible way in which they can affect perceptions and
24 expectations is through their influence on communication behaviors.
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45 Relatively little is known about *how* race-related attitudes and perceptions are manifested in
46 communication behaviors during oncology interactions, or the effects of communication on
47 interaction outcomes. Our own and others' research has shown that non-Black physicians'
48 nonconscious race-related attitudes (i.e., implicit racial bias) influence their communication with
49 Black patients.^{51,53,54} Studies of nonmedical interracial interactions find that implicit bias is more
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3 likely to be expressed through less deliberate nonverbal communication (e.g., facial expressions,
4 posture) than through more deliberate verbal communication (e.g., spoken words).⁵⁵⁻⁵⁸ Black
5 patients' communication may be driven more by explicit than implicit race-related attitudes and
6 perceptions,⁵⁹ but its expression may also be subtle and involve less deliberate communication
7 (e.g., nonverbal behaviors).⁵⁴ The behavioral channels through which these race-related attitudes
8 and perceptions are expressed are not known, but nonverbal synchrony is a promising candidate
9 as one of them.

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

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42 Considerable prior laboratory-based research shows that nonverbal synchrony is often
43 nonconscious, unintentional, and effortless.⁶⁵⁻⁶⁷ However, nonverbal synchrony can be predicted
44 by pre-interaction attitudes⁶⁸ and has post-interaction consequences.⁶⁹ People synchronize more
45 with others with whom they have positive relationships,⁷⁰ those with whom they want to develop
46 positive relationships,⁷¹ and others whom they trust.⁶⁸ In a recent experimental laboratory-based
47 study, individuals with higher implicit bias favoring their own race synchronized more with an
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3 avatar of their own race than with an avatar of a different race.⁷² In terms of nonverbal
4 synchrony's role as a predictor, nonverbal synchrony reflects more subsequent positive affect
5 and liking,⁶⁹ perceptions of similarity, closeness, rapport with the interaction partner, and
6 collaborative problem solving.^{68,73-75} More relevant to clinical communication, nonverbal
7 synchrony has been found to positively influence therapeutic processes,⁷⁶ cooperation,⁷⁷
8 obedience,⁷⁴ and memory for information provided by the interaction partner.^{78,79}
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11 To summarize, current evidence indicates that Black patients and non-Black physicians
12 have negative reactions to each other's race-related attitudes and perceptions. Also, evidence
13 indicates that these attitudes and perceptions are subtly manifested in communication. Little is
14 known, however, about the channels through which these attitudes and perceptions are
15 communicated. Because nonverbal synchrony is subtle, unintentional, automatic, and affect-
16 laden, it may likely serve as a behavioral marker of race-related attitudes and perceptions. Here
17 we describe the protocol for a study that will help fill this gap in understanding by examining the
18 role of nonverbal synchrony in racially concordant and racially discordant oncology interactions.
19 The study was designed to achieve the following *aims* and *hypotheses*, which are based on the
20 research reviewed:
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40 Aim 1: Assess and compare nonverbal synchrony between physicians and patients in
41 racially concordant and racially discordant oncology interactions.
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44 Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in
45 racially discordant oncology interactions.
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49 Aim 2: Determine the influence of nonverbal synchrony on physician communication
50 style (e.g., level of patient-centeredness) and patient and physician affect in racially
51 concordant and racially discordant oncology interactions.
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3 Hypothesis 2: Nonverbal synchrony will positively influence physician patient-
4 centered communication, patient and physician affect, and relational rapport in
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6 racially concordant and racially discordant clinical interactions.
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10 Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially
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12 discordant oncology interactions.
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14 Hypothesis 3: In racially discordant oncology interactions, nonverbal synchrony
15 will significantly negatively covary with patient post-interaction distress and
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17 positively covary with 1) patient post-interaction perceptions of physicians'
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19 patient-centered communication and treatment expectations; 2) physicians' post-
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21 interaction perceptions of patient personal characteristics (e.g., understanding of
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23 treatment options) and their responses to treatment (e.g., willingness to follow
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25 treatment regimen), and 3) observers' ratings of physician patient-centered
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27 communication, patient and physician affect, and relational rapport.
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33 Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction
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35 race-related attitudes and perceptions of the patient and physicians (e.g. physician
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37 implicit bias; patient suspicion).
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40 Aim 4: Develop and test a mediational model that links physician and patient race-related
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42 attitudes and perceptions to nonverbal synchrony and, in turn, outcomes of racially
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44 discordant oncology interactions.
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46 Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-
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48 interaction race-related attitudes and perceptions and post-interaction perceptions
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50 of the patients and physicians.
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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

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

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12 *Participants, Procedures, and Measures in Study One.* Patients from **Study One** who are in the
13 current study include 163 self-identified White (92 male; 71 female) patients who were meeting
14 with a White medical oncologist for the first time to discuss treatment for their cancer. Upon
15 consent, which occurred immediately prior to meeting their oncologist, patients completed a
16 survey assessing their sociodemographic characteristics. Oncologists were 22 White male
17 medical oncologists (no female oncologists participated in **Study One**) who saw at least one
18 participating patient ($M = 7.4$ $SD = 7.0$). Upon consent, oncologists completed a demographic
19 survey. Exam rooms were equipped with unobtrusive digital audio and video recording devices.
20 Studies have demonstrated the nonreactance to the recording process,⁸² and enhanced validity
21 compared to audio recording alone.⁸³
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35 *Participants, Procedures, and Measures in Study Two.* Patients from **Study Two** who are in the
36 current study include 68 Black female patients who were meeting with a non-Black medical
37 oncologist for the time to discuss treatment for their cancer. While patients were recruited for
38 **Study Two** irrespective of sex, only 6 of the patients who enrolled were males. A meaningful
39 statistical comparison on the variables of interest by patient sex cannot be conducted with so few
40 male participants. Thus, we are excluding them from further analyses. Upon consent, patients
41 provided sociodemographic information and completed measures of suspicion of medical care
42 Black patients receive³⁴ and trust in medical institutions.⁸⁴ Oncologists were 16 (7 females; 9
43 males; 8 White; 6 Asian/Pacific Islander; 2 Arab/Middle Eastern) medical oncologists who saw
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3 at least one participating patient ($M = 5.2$, $SD = 6.4$). Upon consent, oncologists completed a
4 demographic survey and the Implicit Association Test, which assesses implicit racial bias against
5 Black people.⁸⁵ Just as in **Study One**, exam rooms in **Study Two** were equipped with
6 unobtrusive digital audio and video recording devices.
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12 In **Study Two**, oncologists were consented upon enrollment, and the video-recorded
13 clinical interactions took place within two weeks after patients consented. Immediately after the
14 interactions, patients completed measures of distress,⁸⁶ perception of the physicians' patient-
15 centered communication,⁸⁷ and expectations about recommended treatment. Also, immediately
16 after interactions, oncologists completed measures of perceptions of the patient and how well the
17 patient would do in treatment. One week later, patients reported their level of trust in their
18 oncologist⁸⁴ in a telephone survey. Trained observers later observed and rated video-recorded
19 interactions to assess physicians' patient-centered communication.⁴⁸ To do this, coders applied a
20 global scale of physicians' patient-centered communication which assessed physicians'
21 informativeness (e.g., "the doctor thoroughly explained everything to the patient");
22 supportiveness (e.g., "the doctor made the patient feel completely at ease during the
23 consultation"); and partnership building (e.g., "the doctor encouraged the patient to express
24 concerns and worries").⁴⁸ At least two observers rated physicians' patient-centered
25 communication (three observers rated 15% of interactions to ensure continued reliability); inter-
26 rater reliability was acceptable (intra-class correlation coefficient = .57-.74, p 's<.05). Each
27 physician's patient-centered communication score was the average of observer ratings.
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49 Five one-minute video slices were created from each of the recordings from the two
50 studies ($N = 340$ slices) by dividing each video recording into five equal segments and selecting
51 the first minute from each segment.^{55,88-90} The slices were observed and rated by naïve observers
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3 who had no training other than instructions to provide their ratings for patient and physician
4 affect (e.g. warm/friendly) and relational rapport (e.g. attentive). The use of naïve observers is
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6 consistent with this type of methodology.^{55,88}
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10 **Hypotheses and Data Analysis.**

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12 **Aim 1: Assess and compare nonverbal synchrony between physicians and patients in**
13 **racially concordant and racially discordant oncology interactions.** We will achieve this aim
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15 by first matching video recordings from **Study One** and **Study Two** on patient and physician sex
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17 and other sociodemographics. Although our focus is on racial concordance/discordance, prior
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19 research suggests that patient and physician sex affects communication in medical interactions.⁹¹⁻
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24 ⁹⁵ However, as described above, matching on sex is constrained by the distributions in the
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26 original recordings. Thus, from **Study One**, we will use 71 White female patients and 92 White
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28 male patients who interacted with White male physicians. From **Study Two**, we will use the 34
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30 Black female patient/non-Black male physician dyads and 34 Black female patient/non-Black
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32 female physician dyads. Thus, within race concordant and race discordant interactions we will
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34 examine the effects of sex concordance and discordance. We acknowledge that this is not a full
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36 factorial design, but it will permit us to examine the influence of race concordance/discordance
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38 on nonverbal synchrony and, also partially examine whether the influence of race on nonverbal
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40 synchrony is moderated by patient and physician sex. To minimize any other differences
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42 between Black patients and White patients, we will also do block matching of patients from
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44 **Study One** with patients from **Study Two** on characteristics that might affect nonverbal
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46 communication (e.g., age, type of cancer). We expect this matching will reduce the number of
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48 patients available from **Study One** by 20-30% percent, but sufficient cases will be available for
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3 well-powered analyses of racial concordance/discordance. We will then further the equivalence
4 of patients with advanced methods of propensity scoring.⁹⁶⁻⁹⁸
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8 We will assess nonverbal synchrony in all matched interactions using customized Motion
9 Energy Analysis (<http://psync.ch/?p=9>)^{76,99} software to obtain synchrony scores for each
10 interaction. Figure 2 is a screenshot of the Motion Energy Analysis software. Motion Energy
11 Analysis is an objective automated method that continuously monitors the amount of movement
12 occurring in pre-defined regions of interest.^{62,76,100} Motion Energy Analysis captures frame-by-
13 frame movement and provides quantification of change in movement in the “regions of interest”.
14 In this study, we consider each individual as one “region of interest,” allowing us to capture full
15 body movement. Motion Energy Analysis uses pixel-differencing methods to measure total
16 amount of movement. We will quantify nonverbal synchrony by deriving scores using windowed
17 cross-correlation matrices to obtain synchrony scores for each interaction.¹⁰¹ Nonverbal
18 synchrony tends to ebb and flow during conversations.⁹¹ Windowed cross-correlation accounts
19 for the possibility of changing synchronization by comparing small sections of time at different
20 time lags. By looking at multiple smaller sections at multiple different lags, windowed cross-
21 correlation is able to estimate synchronization between systems which do not have a constant
22 lag. Figure 3 is windowed cross-correlation output displayed as a heat map with warmer colors
23 representing strong positive correlations between the two individuals’ behavior (e.g., positive
24 nonverbal synchrony) and cooler colors representing strong negative correlations (e.g., negative
25 nonverbal synchrony). These synchrony scores are dyadic attributes that represent amounts and
26 relationships of synchronous movement within dyads. Once we have obtained these scores, we
27 will compare (a) effects of race concordance versus discordance on nonverbal synchrony and (b)
28 effects of sex concordance versus discordance on nonverbal synchrony, and (c) determine the
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3 relative impact of race concordance/discordance versus sex concordance/discordance on
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5 nonverbal synchrony.
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8 *Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in racially*
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10 *discordant oncology interactions.* To obtain time-varying synchrony scores, we will block each
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12 interaction into five equal segments and obtain synchrony scores for each segment using Motion
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14 Energy Analysis. This procedure also allows us to adjust for patients and physicians moving
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16 outside of the regions of interest set at the beginning of each segment and maximizes the
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18 likelihood that we capture all patient and physician movement. For example, this strategy will
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20 help us capture continuous movement even if a patient or physician gets up from a seated
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22 position and walks outside of the pre-determined region of interest. To model changes in
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24 dynamic and overall levels of synchrony, we will use structural equation modeling (SEM)
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26 methods, latent differential equations (LDE), and multi-level modeling (MLM) methods. LDE is
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28 a special case of SEM that allows for estimation of parameters of a proposed underlying
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30 dynamical system. LDE models contain parameters pertaining to the dynamics of a given system
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32 (e.g., “eta” and “zeta” parameters of a latent harmonic oscillator model). We will use multi-
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34 group SEM modeling to test for differences in these parameters between racially concordant and
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36 racially discordant interactions. By using a likelihood ratio test comparing two models where 1)
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38 these dynamic parameters are free to vary and 2) where these parameters are constrained to be
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40 equal across models, we will be able to determine if the motion dynamics differ between racially
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42 concordant and racially discordant interactions. Using a three-level HLM model with time
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44 segments (level 1) nested within patient (level 2), and patient nested within physician (level 3),
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46 we will model changes in nonverbal synchrony based on a categorical variable modeling either
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48 racially concordant or racially discordant interactions. Assuming 168 dyads, an alpha of .05, a
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3 correlation coefficient of .1, and a linear time effect, we have a power of .8 to detect an effect
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5 size of .50.
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8 **Aim 2: Determine the influence of nonverbal synchrony on physician communication and**
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10 **patient and physician affect in racially concordant and racially discordant oncology**
11 **interactions.** We will first collect the same observational measures for **Study One** as in **Study**
12 **Two**, including physician patient-centered communication and patient and physician affect, and
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14 rapport. Trained research assistants will rate each of the racially concordant interactions on
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16 physicians' patient-centered communication.⁴⁸ Next, we will create thin slices of the interactions
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18 from **Study One** and naïve observers will rate the slices using the same measures of physician-
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20 patient affect and rapport as in **Study Two**. Then we will use the synchrony scores from Aim 1
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22 to compare the relationship between nonverbal synchrony and patient-physician affect and
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24 rapport in racially concordant and discordant interactions.
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31 *Hypothesis 2: Nonverbal synchrony will influence physician patient-centered communication,*
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33 *patient and physician affect, and relational rapport in racially concordant and racially*
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35 *discordant clinical interactions.* We will use MLM and multi-group SEM to create a mediation
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37 model where nonverbal synchrony will predict level-2 (patient) and level-3 (physician)
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39 outcomes. Assuming 168 dyads, an alpha of .05, and a correlation coefficient of .1, we have
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41 power of .8 to detect an effect size of .48.
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45 **Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially**
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47 **discordant oncology interactions.** We will achieve this aim using the synchrony scores from
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49 the racially discordant interactions in **Study Two**. We will examine the relationships between
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51 nonverbal synchrony and 1) interaction outcomes collected in the parent study including: patient
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53 satisfaction, distress, perception of physicians' patient-centered communication, and treatment
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3 expectations, and physician perceptions of the patient (e.g., willingness to follow treatment
4 regimen), and 2) pre-interaction physician and patient race-related attitudes and perceptions (e.g.,
5 implicit bias; suspicion), also collected in the parent study.
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10 *Hypothesis 3: In the racially discordant oncology interactions, nonverbal synchrony will*
11 *significantly negatively covary with patient post-interaction distress and positively covary with*
12 *1) patient post-interaction perceptions of physicians' patient-centered communication and*
13 *treatment expectations; 2) physicians' post-interaction perceptions of patient personal*
14 *characteristics (e.g., understanding of treatment options) and their responses to treatment (e.g.,*
15 *willingness to follow treatment regimen); and 3) observers' ratings of physician patient-centered*
16 *communication, patient and physician affect, and relational rapport. Using LDE, we will model*
17 *dynamic parameter values of the fluctuations in nonverbal synchrony over the course of each*
18 *interaction. These values will then be used as first-level predictors in an MLM model. The*
19 *second-level predictors for this model will be values associated with physician and patient post-*
20 *interaction perceptions of the interaction and of each other. Assuming 68 dyads, an alpha of .05,*
21 *and a correlation coefficient of .1, we have a power of .9 to detect an effect size of .56.*
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37 *Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction race-related*
38 *attitudes and perceptions of the patient and physicians (e.g. physician implicit bias, patient*
39 *suspicion). We will create a three-level MLM. We will model synchrony assessed over five time*
40 *segments nested within each patient and each patient nested within physician. Each patient-*
41 *physician dyad will have its own average synchrony score.*
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49 **Aim 4: Develop and test a mediational model that links physician and patient race-related**
50 **attitudes and perceptions to nonverbal synchrony and, in turn, outcomes of race-related**
51 **discordant oncology interactions.**
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3 *Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-interaction race-*
4 *related attitudes and perceptions and post-interaction perceptions of the patients and physicians.*

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8 To examine the proposed mediations in a multilevel context, we will utilize multi-level SEM, as
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10 described by Preacher and colleagues.^{102,103} These models address potential conflated estimates
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12 of mediated effects that can arise when using multi-level data. Time segments will be nested
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14 within each patient and each patient will be nested within physician, with synchrony varying at
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16 each time point. We will use a single mediation model to assess how physician and patient race-
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18 related attitudes and perceptions influence interaction outcomes via their influence on nonverbal
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20 synchrony.
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23 **Patient and Public Involvement.**

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26 Cancer survivors were heavily involved with both **Study One** and **Study Two**.
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28 Investigators had extensive conversations with survivors about their experiences as patients and
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30 survivors, which helped guide the research questions, measured outcomes, and design of both
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32 studies.
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36 Patients were not directly involved with developing the research questions and outcomes
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38 for this secondary analysis. However, this work extends naturally from the considerable previous
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40 work we have done focused on understanding and improving patient-oncologist communication
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42 for all patients, with special attention to patients more vulnerable to cancer treatment and
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44 mortality disparities. This secondary analysis will investigate another important aspect of patient-
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46 physician communication that our patient and physician partners have agreed needs research
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48 attention.
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52 Recruitment to both **Study One** and **Study Two** was done by the investigators and their
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54 research and clinic staff. As PI, Dr. Hamel will disseminate results from this investigation
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3 through the Karmanos Cancer Institutes' Department of Community Outreach and Education,
4 which has regularly scheduled meetings with cancer survivors, caretakers, and community
5 stakeholders.
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10 **ETHICS AND DISSEMINATION**

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12 Studies one, two, and the current study are all IRB-approved. Only patients and
13 physicians from the previous studies who provided their consent for secondary analyses of their
14 data were included in the current study. The nature of the data makes it unlikely we will
15 encounter ethical or safety issues.
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21 We will submit our ongoing findings to relevant communication, social psychology, and
22 oncology conferences. Similarly, we plan to submit the final manuscripts to high-impact
23 communication, social psychology, and oncology peer-reviewed journals.
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28 **LIMITATIONS**

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30 Although this secondary analysis is innovative in its focus and methods, it is not without
31 limitations. First, this study takes advantage of existing datasets, but the video-recorded and self-
32 report data were not collected with the current hypotheses in mind. Second, the data are not
33 evenly distributed by sex and race. As is often the case with medical research involving actual
34 patients, the distributions of study patient characteristics are constrained by the distributions of
35 patient demographic and medical characteristics of the patients that are treated at the
36 participating hospitals. This reality precludes us from fully examining all combinations of race
37 and sex. However, there are advantages to the fact that this research is conducted in a real-world,
38 rather than a laboratory setting; also, we are able to account for some variability in our models by
39 treating certain factors (e.g., cancer type) as random effects. Last, although given a design that is
40 adequately powered to make both between- and within-subject comparisons, it is still possible
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3 we may find no significant findings regarding nonverbal synchrony. Of course, this finding
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5 would be interesting in and of itself and would direct research attention to other avenues of
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7 investigation.
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10 11 12 **FIGURE LEGEND**

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14 Figure 1: Conceptual Model

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17 Figure 2: Motion Energy Analysis Software

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21 Figure 3: Window Cross Correlation Output
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REFERENCES

1. National Center for Health Statistics. *Health, United States, 2015: with special feature on racial and ethnic health disparities*. Hyattsville, MD, 2016.
2. Murphy CC, Harlan LC, Warren JL, et al. Race and insurance differences in the receipt of adjuvant chemotherapy among patients with stage III colon cancer. *J Clin Oncol*. 2015;33(23):2530-2536.
3. Bach PB, Schrag D, Brawley OW, et al. Survival of blacks and whites after a cancer diagnosis. *JAMA*. 2002;287(16):2106-2113.
4. Greenwald HP, Polissar NL, Borgatta EF, et al. Social factors, treatment, and survival in early-stage non-small cell lung cancer. *Am J Public Health*. 1998;88(11):1681-1684.
5. Ramsey SD, Howlader N, Etzioni RD, et al. Chemotherapy use, outcomes, and costs for older persons with advanced non-small-cell lung cancer: evidence from surveillance, epidemiology and end results-Medicare. *J Clin Oncol*. 2004;22(24):4971-4978.
6. Smedley BD, Stith AY, Nelson AR. *Unequal treatment: confronting racial and ethnic disparities in health care*. Institute of Medicine, 2003.
7. Tehranifar P, Neugut AI, Phelan JC, et al. Medical advances and racial/ethnic disparities in cancer survival. *Cancer Epidemiol Biomarkers Prev*. 2009;18(10):2701-2708.
8. Patel MI, Ma Y, Mitchell B, et al. How do differences in treatment impact racial and ethnic disparities in acute myeloid leukemia? *Cancer Epidemiol Biomarkers Prev*. 2015;24(2):344-349.
9. Ward E, Jemal A, Cokkinides V, et al. Cancer disparities by race/ethnicity and socioeconomic status. *CA Cancer J Clin*. 2004;54(2):78-93.
10. Ghafoor A, Jemal A, Ward E, et al. Trends in breast cancer by race and ethnicity. *CA Cancer J Clin*. 2003;53(6):342-355.
11. Jemal A, Siegel R, Ward E, et al. Cancer statistics, 2006. *CA Cancer J Clin*. 2006;56(2):106-130.
12. Siegel R, Ma J, Zou Z, et al. Cancer statistics, 2014. *CA Cancer J Clin*. 2014;64(1):9-29.
13. Hardy D, Liu CC, Xia R, et al. Racial disparities and treatment trends in a large cohort of elderly black and white patients with nonsmall cell lung cancer. *Cancer*. 2009;115(10):2199-2211.
14. Agency for Healthcare Research and Quality. 2014 National Healthcare Quality and Disparities Report. Rockville, MD, 2015.
15. Griggs JJ, Sorbero ME, Stark AT, et al. Racial disparity in the dose and dose intensity of breast cancer adjuvant chemotherapy. *Breast Cancer Res Treat*. 2003;81(1):21-31.
16. Morris AM, Billingsley KG, Hayanga AJ, et al. Residual treatment disparities after oncology referral for rectal cancer. *J Natl Cancer Inst*. 2008;100(10):738-744.
17. Berger M, Lund MJ, Brawley OW. Racial disparities in lung cancer. *Curr Probl Cancer*. 2007;31(3):202-210.
18. Daly B, Olopade OI. A perfect storm: How tumor biology, genomics, and health care delivery patterns collide to create a racial survival disparity in breast cancer and proposed interventions for change. *CA Cancer J Clin*. 2015;65(3):221-238.

19. Hayn MH, Orom H, Shavers VL, et al. Racial/ethnic differences in receipt of pelvic lymph node dissection among men with localized/regional prostate cancer. *Cancer*. 2011;117(20):4651-4658.
20. Penner LA, Eggly S, Griggs JJ, et al. Life-threatening disparities: the treatment of black and white cancer patients. *J Soc Issues*. 2012;68(2).
21. Meghani SH, Kang Y, Chittams J, et al. African Americans with cancer pain are more likely to receive an analgesic with toxic metabolite despite clinical risks: a mediation analysis study. *J Clin Oncol*. 2014;32(25):2773-2779.
22. Hassett MJ, Schymura MJ, Chen K, et al. Variation in breast cancer care quality in New York and California based on race/ethnicity and Medicaid enrollment. *Cancer*. 2015.
23. Phelan JC, Link BG. Is racism a fundamental cause of inequalities in health? *Annual Rev Soc, Vol 41*. 2015;41:311-330.
24. Jean-Pierre P, Fiscella K, Griggs J, et al. Race/ethnicity-based concerns over understanding cancer diagnosis and treatment plan. *J Natl Med Assoc*. 2010;102(3):184-189.
25. Eggly S, Harper FW, Penner LA, et al. Variation in question asking during cancer clinical interactions: a potential source of disparities in access to information. *Patient Educ Couns*. 2011;82(1):63-68.
26. Eggly S, Barton E, Winckles A, et al. A disparity of words: racial differences in oncologist-patient communication about clinical trials. *Health Expect*. 2015;18(5):1316-1326.
27. Gordon HS, Street RL, Jr., Sharf BF, et al. Racial differences in doctors' information-giving and patients' participation. *Cancer*. 2006;107(6):1313-1320.
28. Gordon HS, Street RL, Jr., Sharf BF, et al. Racial differences in trust and lung cancer patients' perceptions of physician communication. *J Clin Oncol*. 2006;24(6):904-909.
29. Siminoff LA, Graham GC, Gordon NH. Cancer communication patterns and the influence of patient characteristics: disparities in information-giving and affective behaviors. *Patient Educ Couns*. 2006;62(3):355-360.
30. Song L, Hamilton JB, Moore AD. Patient-healthcare provider communication: perspectives of African American cancer patients. *Health Psychol*. 2012;31(5):539-547.
31. Penner LA, Dovidio JF, West TV, et al. Aversive racism and medical interactions with black patients: a field study. *J Exp Soc Psychol*. 2010;46(2):436-440.
32. Boulware LE, Cooper LA, Ratner LE, et al. Race and trust in the health care system. *Public Health Rep*. 2003;118(4):358-365.
33. Nguyen GC, LaVeist TA, Harris ML, et al. Patient trust-in-physician and race are predictors of adherence to medical management in inflammatory bowel disease. *Inflamm Bowel Dis*. 2009;15(8):1233-1239.
34. Thompson HS, Valdimarsdottir HB, Winkel G, et al. The Group-Based Medical Mistrust Scale: psychometric properties and association with breast cancer screening. *Prev Med*. 2004;38(2):209-218.
35. Bird ST, Bogart LM. Perceived race-based and socioeconomic status(SES)-based discrimination in interactions with health care providers. *Ethn Dis*. 2001;11(3):554-563.
36. Bird ST, Bogart LM, Delahanty DL. Health-related correlates of perceived discrimination in HIV care. *AIDS Patient Care STDS*. 2004;18(1):19-26.
37. O'Malley AS, Sheppard VB, Schwartz M, et al. The role of trust in use of preventive services among low-income African-American women. *Prev Med*. 2004;38(6):777-785.

- 1
- 2
- 3 38. Green AR, Carney DR, Pallin DJ, et al. Implicit bias among physicians and its prediction
- 4 of thrombolysis decisions for black and white patients. *J Gen Intern Med.*
- 5 2007;22(9):1231-1238.
- 6
- 7 39. Hagiwara N, Penner LA, Gonzalez R, et al. Racial attitudes, physician-patient talk time
- 8 ratio, and adherence in racially discordant medical interactions. *Soc Sci Med.*
- 9 2013;87:123-131.
- 10
- 11 40. Cooper LA, Roter DL, Carson KA, et al. The associations of clinicians' implicit attitudes
- 12 about race with medical visit communication and patient ratings of interpersonal care. *Am*
- 13 *J Public Health.* 2012;102(5):979-987.
- 14
- 15 41. Blair IV, Steiner JF, Fairclough DL, et al. Clinicians' implicit ethnic/racial bias and
- 16 perceptions of care among Black and Latino patients. *Ann Fam Med.* 2013;11(1):43-52.
- 17
- 18 42. Hausmann LR, Myaskovsky L, Niyonkuru C, et al. Examining implicit bias of physicians
- 19 who care for individuals with spinal cord injury: A pilot study and future directions. *J*
- 20 *Spinal Cord Med.* 2015;38(1):102-110.
- 21
- 22 43. Hamel LM, Chapman R, Malloy M, et al. Critical shortage of African American medical
- 23 oncologists in the United States. *J Clin Oncol.* 2015;33(32):3697-3700.
- 24
- 25 44. Kirkwood MK, Kosty MP, Bajorin DF, et al. Tracking the workforce: the American
- 26 Society of Clinical Oncology workforce information system. *J Oncol Pract.* 2013;9(1):3-
- 27 8.
- 28
- 29 45. Cooper-Patrick L, Gallo JJ, Gonzales JJ, et al. Race, gender, and partnership in the
- 30 patient-physician relationship. *JAMA.* 1999;282(6):583-589.
- 31
- 32 46. Cooper LA, Roter DL, Johnson RL, et al. Patient-centered communication, ratings of
- 33 care, and concordance of patient and physician race. *Ann Intern Med.* 2003;139(11):907-
- 34 915.
- 35
- 36 47. Johnson RL, Roter D, Powe NR, et al. Patient race/ethnicity and quality of patient-
- 37 physician communication during medical visits. *Am J Public Health.* 2004;94(12):2084-
- 38 2090.
- 39
- 40 48. Street RL, Jr., Gordon H, Haidet P. Physicians' communication and perceptions of
- 41 patients: is it how they look, how they talk, or is it just the doctor? *Soc Sci Med.*
- 42 2007;65(3):586-598.
- 43
- 44 49. Elliott AM, Alexander SC, Mescher CA, et al. Differences in physicians' verbal and
- 45 nonverbal communication With black and white patients at the end of life. *J Pain*
- 46 *Symptom Manage.* 2016;51(1):1-8.
- 47
- 48 50. Penner LA, Gaertner S, Dovidio JF, et al. A social psychological approach to improving
- 49 the outcomes of racially discordant medical interactions. *J Gen Intern Med.*
- 50 2013;28(9):1143-1149.
- 51
- 52 51. Penner LA, Dovidio JF, Gonzalez R, et al. The effects of oncologist implicit racial bias in
- 53 racially discordant oncology interactions. *J Clin Oncol.* 2016;34(24):2874-2880.
- 54
- 55 52. Penner LA, Harper FWK, Dovidio JF, et al. The impact of Black cancer patients' race-
- 56 related beliefs and attitudes on racially-discordant oncology interactions: A field study.
- 57 *Soc Sci Med.* 2017;191:99-108.
- 58
- 59 53. Penner LA, Blair IV, Albrecht TL, et al. Reducing racial health care disparities: a social
- 60 psychological analysis. *Policy Insights Behav Brain Sci.* 2014;1(1):204-212.
- 54 54. Hamel LM, Manning MA, Penner LA, et al. Racial attitudes and nonverbal convergence
- of patients and physicians in oncology interactions. Published Abstract from the

- 1
2
3 Proceedings of the Society of Behavioral Medicine's Annual Meeting. *Annals Behav Med*
4 2017;51(1_suppl):S1742.
- 5 55. Richeson JA, Shelton JN. Brief report: Thin slices of racial bias. *J Nonverbal Behav.*
6 2005;29(1):75-86.
- 7 56. Dovidio JF, Kawakami K, Gaertner SL. Implicit and explicit prejudice and interracial
8 interaction. *J Person Soc Psychol.* 2002;82(1):62-68.
- 9 57. Dovidio JF, Kawakami K, Johnson C, et al. On the nature of prejudice: Automatic and
10 controlled processes. *J Exper Soc Psychol.* 1997;33(5):510-540.
- 11 58. Dovidio JF, LaFrance M. Race, ethnicity, and nonverbal behavior. In: Hall JA, Knapp M,
12 eds. *Nonverbal Communication.* The Hague, The Netherlands: DeGruyter-Mouton;
13 2013:671-696.
- 14 59. Penner LA, Hagiwara N, Eggly S, et al. Racial healthcare disparities: a social
15 psychological analysis. *Eur Rev Soc Psychol.* 2013;24(1):70-122.
- 16 60. Kimura M, Daibo I. Interactional synchrony in conversations about emotional episodes:
17 A measurement by "the between-participants pseudosynchrony experimental paradigm".
18 *J Nonverbal Behav.* 2006;30(3):115-126.
- 19 61. Condon WS, Ogston WD. Sound film analysis of normal and pathological behavior
20 patterns. *J Nerv Ment Dis.* 1966;143(4):338-347.
- 21 62. Ramseyer F, Tschacher W. Nonverbal synchrony or random coincidence? How to tell the
22 difference. *Development of Multimodal Interfaces: Active Listening and Synchrony.*
23 2010;5967:182-196.
- 24 63. Moulder RG, Boker SM, Ramseyer F, et al. Determining synchrony between behavioral
25 time series: An application of surrogate data generation for establishing falsifiable null-
26 hypotheses. *Psychol Methods.* 2018, epub.
- 27 64. Ramseyer F, Tschacher W. Synchrony: a core concept for a constructivist approach to
28 psychotherapy. *Constructivism in the Human Sciences.* 2006;11:150-171.
- 29 65. Chartrand TL, Lakin JL. The antecedents and consequences of human behavioral
30 mimicry. *Annual Rev Psychol, Vol 64.* 2013;64:285-308.
- 31 66. White K, Argo JJ. When imitation doesn't flatter: the role of consumer distinctiveness in
32 responses to mimicry. *J Consumer Res.* 2011;38(4):667-680.
- 33 67. Chartrand TL, Maddux WW, Lakin JL. Beyond the perception-behavior link: The
34 ubiquitous utility and motivational moderators of nonconscious mimicry. In: Hassin RR,
35 Uleman JS, Bargh JA, eds. *The New Unconscious:* Oxford University Press; 2005:334-
36 361.
- 37 68. Vacharkulksemsuk T, Fredrickson BL. Strangers in sync: achieving embodied rapport
38 through shared movements. *J Exp Soc Psychol.* 2012;48(1):399-402.
- 39 69. Hove MJ, Risen JL. It's all in the timing: interpersonal synchrony increases affiliation.
40 *Soc Cog.* 2009;27(6):949-960.
- 41 70. Miles LK, Griffiths JL, Richardson MJ, et al. Too late to coordinate: contextual
42 influences on behavioral synchrony. *Eur J Soc Psychol.* 2010;40(1):52-60.
- 43 71. Miles LK, Lumsden J, Richardson MJ, et al. Do birds of a feather move together? Group
44 membership and behavioral synchrony. *Exp Brain Res.* 2011;211(3-4):495-503.
- 45 72. Sacheli LM, Christensen A, Giese MA, et al. Prejudiced interactions: implicit racial bias
46 reduces predictive simulation during joint action with an out-group avatar. *Scientific*
47 *Reports.* 2015;5.
- 48
49
50
51
52
53
54
55
56
57
58
59
60

- 1
- 2
- 3 73. Paladino MP, Mazzelega M, Pavani F, et al. Synchronous multisensory stimulation blurs self-other boundaries. *Psychol Sci*. 2010;21(9):1202-1207.
- 4
- 5 74. Wiltermuth S. Synchrony and destructive obedience. *Soc Influ*. 2012;7(2):78-89.
- 6
- 7 75. Wiltshire TJ, Steffensen SV, Fiore SM. Multiscale movement coordination dynamics in collaborative team problem solving. *Appl Ergon*. 2018.
- 8
- 9 76. Ramseyer F, Tschacher W. Nonverbal synchrony in psychotherapy: coordinated body movement reflects relationship quality and outcome. *J Consult Clinic Psychol*. 2011;79(3):284-295.
- 10
- 11
- 12 77. Valdesolo P, Ouyang J, DeSteno D. The rhythm of joint action: synchrony promotes cooperative ability. *J Exp Soc Psychol*. 2010;46(4):693-695.
- 13
- 14 78. Macrae CN, Duffy OK, Miles LK, et al. A case of hand waving: action synchrony and person perception. *Cognition*. 2008;109(1):152-156.
- 15
- 16 79. Miles LK, Nind LK, Henderson Z, et al. Moving memories: behavioral synchrony and memory for self and others. *J Exp Soc Psychol*. 2010;46(2):457-460.
- 17
- 18 80. Albrecht TL, Eggly SS, Gleason ME, et al. Influence of clinical communication on patients' decision making on participation in clinical trials. *J Clin Oncol*. 2008;26(16):2666-2673.
- 19
- 20
- 21
- 22
- 23 81. Eggly S, Hamel LM, Foster TS, et al. Randomized trial of a question prompt list to increase patient active participation during interactions with black patients and their oncologists. *Patient Educ Couns*. 2017;100(5):818-826.
- 24
- 25
- 26 82. Penner LA, Orom H, Albrecht TL, et al. Camera-related behaviors during video recorded medical interactions. *J Nonverbal Behav*. 2007;31(2):99-117.
- 27
- 28 83. Riddle DL, Albrecht TL, Coovert MD, et al. Differences in audiotaped versus videotaped physician-patient interactions. *J Nonverbal Behav*. 2002;26(4):219-239.
- 29
- 30
- 31 84. Dugan E, Trachtenberg F, Hall MA. Development of abbreviated measures to assess patient trust in a physician, a health insurer, and the medical profession. *BMC Health Serv Res*. 2005;5:64.
- 32
- 33
- 34 85. Greenwald AG, Nosek BA, Banaji MR. Understanding and using the implicit association test: I. an improved scoring algorithm. *J Pers Soc Psychol*. 2003;85(2):197-216.
- 35
- 36 86. Jacobsen PB. Screening for psychological distress in cancer patients: challenges and opportunities. *J Clin Oncol*. 2007;25(29):4526-4527.
- 37
- 38 87. Stewart M, Brown JB, Weston WW, TR. F. The impact of patient-centered care on outcomes. *J Fam Pract*. 2000;49(9):796-804.
- 39
- 40
- 41 88. Ambady N, Rosenthal R. Thin slices of expressive behavior as predictors of interpersonal consequences - a Metaanalysis. *Psychol Bull*. 1992;111(2):256-274.
- 42
- 43 89. Murphy NA. Using thin slices for behavioral coding. *J Nonverbal Behav*. 2005;29(4):235-246.
- 44
- 45
- 46 90. Roter DL, Hall JA, Blanch-Hartigan D, et al. Slicing it thin: new methods for brief sampling analysis using RIAS-coded medical dialogue. *Patient Educ Counsel*. 2011;82(3):410-419.
- 47
- 48
- 49 91. Roter DL, Hall JA, Aoki Y. Physician gender effects in medical communication: a meta-analytic review. *JAMA*. 2002;288(6):756-764.
- 50
- 51 92. Janssen SM, Lagro-Janssen AL. Physician's gender, communication style, patient preferences and patient satisfaction in gynecology and obstetrics: a systematic review. *Patient Educ Couns*. 2012;89(2):221-226.
- 52
- 53
- 54
- 55
- 56
- 57
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93. Schieber AC, Delpierre C, Lepage B, et al. Do gender differences affect the doctor-patient interaction during consultations in general practice? Results from the INTERMEDE study. *Fam Pract*. 2014;31(6):706-713.
94. Inglehart MR. Interactions between patients and dental care providers: does gender matter? *Dent Clin North Am*. 2013;57(2):357-370.
95. Bertakis KD, Azari R. Patient-centered care: the influence of patient and resident physician gender and gender concordance in primary care. *J Womens Health (Larchmt)*. 2012;21(3):326-333.
96. Iacus SM KG, Porro G. Causal inference without balance checking: Coarsened exact matching. *Political Analysis* 2012;20(1):1-24.
97. King GN, R. Why propensity scores should not be used for matching. *Working Paper*. 2016.
98. Austin PC. An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behav Res*. 2011;46(3):399-424.
99. *Motion Energy Analysis (MEA) [Computer software]*. [computer program]. Retrieved from <http://www.psync.ch2016>.
100. Ramseyer F, Tschacher W. Nonverbal synchrony in psychotherapy: Coordinated movement, the therapeutic relationship and outcome. *Internat J Psychol*. 2008;43(3-4):59-59.
101. Boker SM, Xu MQ, Rotondo JL, et al. Windowed cross-correlation and peak picking for the analysis of variability in the association between behavioral time series. *Psychol Methods*. 2002;7(3):338-355.
102. Preacher KJ, Zyphur MJ, Zhang Z. A general multilevel SEM framework for assessing multilevel mediation. *Psychol Methods*. 2010;15(3):209-233.
103. Preacher KJ, Zhang Z, Zyphur MJ. Alternative methods for assessing mediation in multilevel data: the advantages of multilevel SEM. *Structural Equation Modeling-a Multidisciplinary Journal*. 2011;18(2):161-182.

Authors' Statement:

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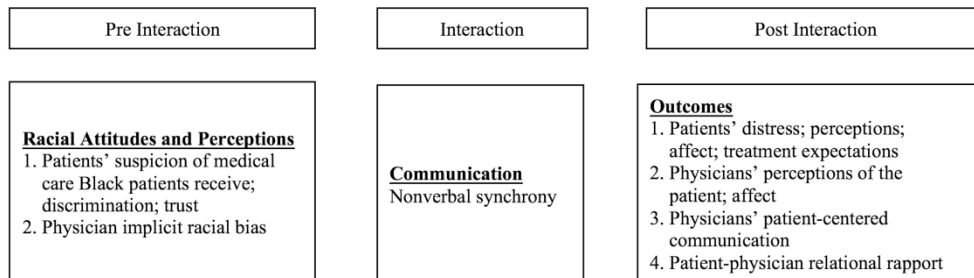
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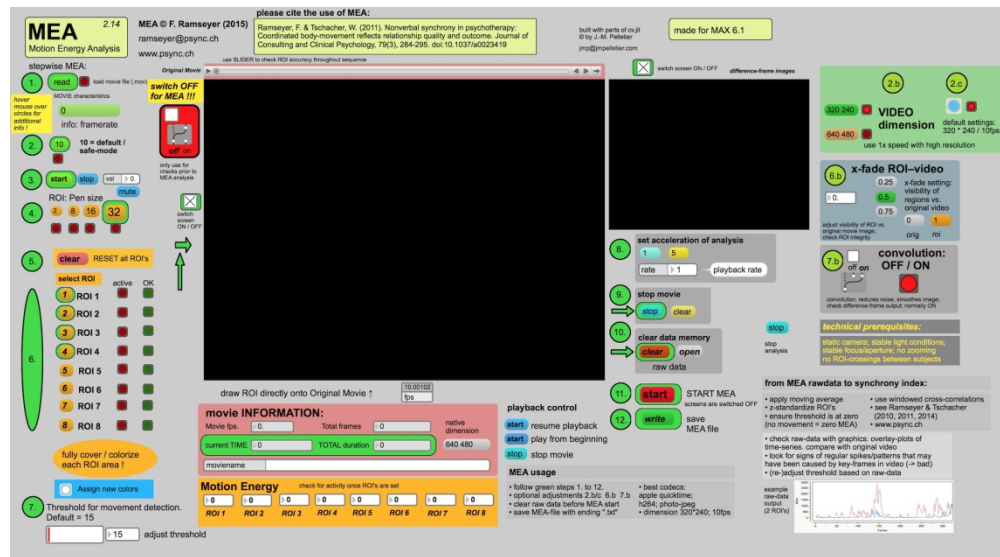
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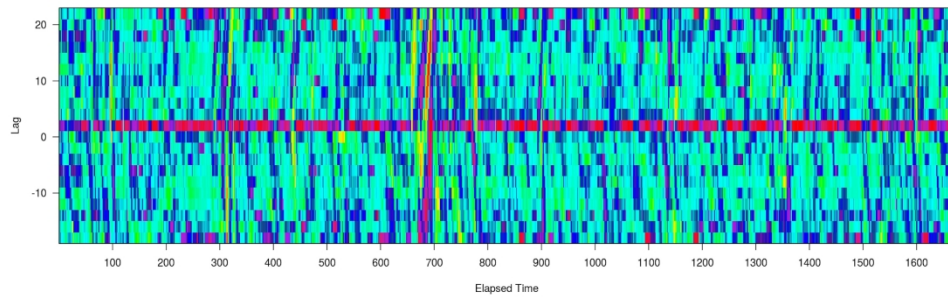
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BMJ Open

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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4 **attitudes and a predictor of outcomes in oncology interactions:**
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For peer review only

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 questions²⁵ and are less likely to participate in decision making,⁴⁵ whereas physicians tend to be less patient-centered,^{46,47} more

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3 verbally dominant,⁴⁷ more contentious,⁴⁸ exhibit fewer rapport building nonverbal behaviors,⁴⁹
4 and provide less information.²⁷ Physicians and patients show fewer expressions of positive
5 affect⁴⁷ and relationship-building attempts.²⁹
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10 Patient and physician race-related attitudes and perceptions affect interaction outcomes via
11 communication behaviors. Prior research, including our own, suggests that *race-related attitudes*
12 *and perceptions* (e.g., physician implicit bias against Black people, patient suspicion of medical
13 care Black people receive) affect communication in clinical interactions and perceptions
14 physicians and patients have of each other during racially discordant clinical interactions.^{31-33,37,38}
15 For example, physicians with higher levels of implicit (unconscious) bias against Black people
16 are perceived as less patient-centered and less trustworthy by their Black patients than physicians
17 with lower levels of implicit bias against Black people.^{31,40,41,50} Our prior research suggests such
18 perceptions and behaviors are associated with less positive patient expectations about
19 recommended treatments.⁵¹ We have also found that Black patients with higher levels of
20 suspicion of medical care are less optimistic about outcomes of recommended treatments and are
21 perceived by their physicians to be less educated.⁵² This, in turn, is associated with less positive
22 physician expectations about how their Black patients will do on a treatment protocol, such as
23 their adherence and/or ability to tolerate treatment. Given that these attitudes and perceptions are
24 not directly observable, the only possible way in which they can affect perceptions and
25 expectations is through their influence on communication behaviors.
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47 Relatively little is known about *how* race-related attitudes and perceptions are manifested in
48 communication behaviors during oncology interactions, or the effects of communication on
49 interaction outcomes. Our own and others' research has shown that non-Black physicians'
50 unconscious race-related attitudes (i.e., implicit racial bias) influence their communication with
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3 Black patients.^{51,53,54} Studies of nonmedical interracial interactions find that implicit bias is more
4 likely to be expressed through less deliberate nonverbal communication (e.g., facial expressions,
5 posture) than through more deliberate verbal communication (e.g., spoken words).⁵⁵⁻⁵⁸ Black
6 patients' communication may be driven more by explicit than implicit race-related attitudes and
7 perceptions,⁵⁹ but its expression may also be subtle and involve less deliberate communication
8 (e.g., nonverbal behaviors).⁵⁴ The behavioral channels through which these race-related attitudes
9 and perceptions are expressed are not known, but nonverbal synchrony is a promising candidate
10 as one of them.

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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 attitudes⁶⁸ 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

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3 study, individuals with higher implicit bias favoring their own race synchronized more with an
4 avatar of their own race than with an avatar of a different race.⁷² In terms of nonverbal
5 synchrony's role as a predictor, nonverbal synchrony reflects more subsequent positive affect
6 and liking,⁶⁹ perceptions of similarity, closeness, rapport with the interaction partner, and
7 collaborative problem solving.^{68,73-75} More relevant to clinical communication, nonverbal
8 synchrony has been found to positively influence therapeutic processes,⁷⁶ cooperation,⁷⁷
9 obedience,⁷⁴ and memory for information provided by the interaction partner.^{78,79} It is because of
10 this previous research that we will investigate general nonverbal synchrony in this study, rather
11 than, for example, vocal synchrony or synchrony of more precise behaviors such as eye gaze.
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24 To summarize, current evidence indicates that Black patients and non-Black physicians
25 have negative reactions to each other's race-related attitudes and perceptions. Also, evidence
26 indicates that these attitudes and perceptions are subtly manifested in communication. Little is
27 known, however, about the channels through which these attitudes and perceptions are
28 communicated. Because nonverbal synchrony is subtle, unintentional, automatic, and affect-
29 laden, it may likely serve as a behavioral marker of race-related attitudes and perceptions. Here
30 we describe the protocol for a study that will help fill this gap in understanding by examining the
31 role of nonverbal synchrony in racially concordant and racially discordant oncology interactions.
32 The study was designed to achieve the following *aims* and *hypotheses*, which are based on the
33 research reviewed:
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47 Aim 1: Assess and compare nonverbal synchrony between physicians and patients in
48 racially concordant and racially discordant oncology interactions.
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51 Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in
52 racially discordant oncology interactions.
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3 Aim 2: Determine the influence of nonverbal synchrony on physician communication
4 style (e.g., level of patient-centeredness) and patient and physician affect in racially
5 concordant and racially discordant oncology interactions.
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10 Hypothesis 2: Nonverbal synchrony will positively influence physician patient-
11 centered communication, patient and physician affect, and relational rapport in
12 racially concordant and racially discordant clinical interactions.
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17 Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially
18 discordant oncology interactions.
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21 Hypothesis 3: In racially discordant oncology interactions, nonverbal synchrony
22 will significantly negatively covary with patient post-interaction distress and
23 positively covary with 1) patient post-interaction perceptions of physicians'
24 patient-centered communication and treatment expectations; 2) physicians' post-
25 interaction perceptions of patient personal characteristics (e.g., understanding of
26 treatment options) and their responses to treatment (e.g., willingness to follow
27 treatment regimen), and 3) observers' ratings of physician patient-centered
28 communication, patient and physician affect, and relational rapport.
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39 Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction
40 race-related attitudes and perceptions of the patient and physicians (e.g. physician
41 implicit bias; patient suspicion).
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47 Aim 4: Develop and test a mediational model that links physician and patient race-related
48 attitudes and perceptions to nonverbal synchrony and, in turn, outcomes of racially
49 discordant oncology interactions.
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3 Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-
4 interaction race-related attitudes and perceptions and post-interaction perceptions
5 of the patients and physicians.
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12 **METHODS AND ANALYSIS**

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14 **Overview of proposed study.** Our goals are to: 1) compare the extent to which physicians and
15 patients synchronize their behavior in racially concordant and racially discordant oncology
16 interactions; 2) compare the associations between nonverbal synchrony and self-report and
17 observational measures of patient and physician affect and physicians' patient-centered
18 communication in racially concordant and racially discordant oncology interactions; 3)
19 investigate how race-related attitudes and perceptions (e.g., physician implicit bias, patient
20 suspicion) affect nonverbal synchrony in racially discordant oncology interactions; 4) investigate
21 how nonverbal synchrony affects the outcomes of racially discordant clinical interactions; and 5)
22 test the conceptual model in Figure 1, which predicts that race-related attitudes and perceptions
23 will be associated with patient and physician perceptions and treatment-related outcomes of
24 racially discordant oncology interactions, through their influence on nonverbal synchrony. To
25 achieve these goals, we will conduct a secondary analysis of data from two studies conducted by
26 members of our study team. This secondary analysis was officially funded in September 2017.
27 Thus, it is ongoing and will be completed by August 2019. **Study One**, which was funded by the
28 National Cancer Institute (NCI), was conducted at two NCI-designated comprehensive cancer
29 centers between April 2002 and March 2006 (R01CA75003),⁸⁰ was an investigation of how
30 patient-oncologist communication influences patients' decision making about treatment
31 including clinical trials. **Study Two** (also funded by the NCI), was conducted at one of the **Study**
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3 **One** NCI-designated centers plus another large urban cancer clinic in the same city between
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5 April 2012 and December 2014. **Study Two** investigated associations between communication
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7 and outcomes during racially discordant oncology interactions (U54CA153606-04).⁸¹ Only
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9 patients and oncologists from these studies who agreed on their consent forms to allow their
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11 video-recorded and self-reported data to be used in secondary analyses will be used in the current
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13 study. Comparisons of groups did not find any socio-demographic or attitudinal differences
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15 between patients/oncologists who did and did not agree to be in secondary analyses.
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19 **Data Sources.**

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21 *Participants, Procedures, and Measures in Study One.* Patients from **Study One** who are in the
22
23 current study include 163 self-identified White (92 male; 71 female) patients who were meeting
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25 with a White medical oncologist for the first time to discuss treatment for their cancer. Upon
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27 consent, which occurred immediately prior to meeting their oncologist, patients completed a
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29 survey assessing their sociodemographic characteristics. Oncologists were 22 White male
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31 medical oncologists (no female oncologists participated in **Study One**) who saw at least one
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33 participating patient ($M = 7.4$ $SD = 7.0$). Upon consent, oncologists completed a demographic
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35 survey. Exam rooms were equipped with unobtrusive digital audio and video recording devices.
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37 Studies have demonstrated the nonreactance to the recording process,⁸² and enhanced validity
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39 compared to audio recording alone.⁸³
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45 *Participants, Procedures, and Measures in Study Two.* Patients from **Study Two** who are in the
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47 current study include 68 Black female patients who were meeting with a non-Black medical
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49 oncologist for the time to discuss treatment for their cancer. While patients were recruited for
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51 **Study Two** irrespective of sex, only 6 of the patients who enrolled were males. A meaningful
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53 statistical comparison on the variables of interest by patient sex cannot be conducted with so few
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3 male participants. Thus, we are excluding them from further analyses. Upon consent, patients
4 provided sociodemographic information and completed measures of suspicion of medical care
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6 Black patients receive³⁴ and trust in medical institutions.⁸⁴ There were 16 medical oncologists (7
7 females; 9 males; 8 White; 6 Asian/Pacific Islander; 2 Arab/Middle Eastern) who saw at least
8 one participating patient ($M = 5.2$, $SD = 6.4$). Upon consent, oncologists completed a
9 demographic survey and the Implicit Association Test, which assesses implicit racial bias against
10 Black people.⁸⁵ Just as in **Study One**, exam rooms in **Study Two** were equipped with
11 unobtrusive digital audio and video recording devices.
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21 In **Study Two**, oncologists were consented upon enrollment, and the video-recorded
22 clinical interactions took place within two weeks after patients consented. Immediately after the
23 interactions, patients completed measures of distress,⁸⁶ perception of the physicians' patient-
24 centered communication,⁸⁷ and expectations about recommended treatment. Also, immediately
25 after interactions, oncologists completed measures of perceptions of the patient and how well the
26 patient would do in treatment. One week later, patients reported their level of trust in their
27 oncologist⁸⁴ in a telephone survey. Trained observers later observed and rated video-recorded
28 interactions to assess physicians' patient-centered communication.⁴⁸ To do this, coders applied a
29 global scale of physicians' patient-centered communication which assessed physicians'
30 informativeness (e.g., "the doctor thoroughly explained everything to the patient");
31 supportiveness (e.g., "the doctor made the patient feel completely at ease during the
32 consultation"); and partnership building (e.g., "the doctor encouraged the patient to express
33 concerns and worries").⁴⁸ At least two observers rated physicians' patient-centered
34 communication (three observers rated 15% of interactions to ensure continued reliability); inter-
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3 rater reliability was acceptable (intra-class correlation coefficient = .57-.74, p 's<.05). Each
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5 physician's patient-centered communication score was the average of observer ratings.
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8 Five one-minute video slices were created from each of the recordings from the two
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10 studies (N = 340 slices) by dividing each video recording into five equal segments and selecting
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12 the first minute from each segment.^{55,88-90} The slices were observed and rated by naïve observers
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14 who had no training other than instructions to provide their ratings for patient and physician
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16 affect (e.g. warm/friendly) and relational rapport (e.g. attentive). The use of naïve observers is
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18 consistent with this type of methodology.^{55,88}
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21 **Hypotheses and Data Analysis.**

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24 **Aim 1: Assess and compare nonverbal synchrony between physicians and patients in**
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26 **racially concordant and racially discordant oncology interactions.** We will achieve this aim
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28 by first matching video recordings from **Study One** and **Study Two** on patient and physician sex
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30 and other sociodemographics. Although our focus is on racial concordance/discordance, prior
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32 research suggests that patient and physician sex affects communication in medical interactions.⁹¹⁻
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35 ⁹⁵ However, as described above, matching on sex is constrained by the distributions in the
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37 original recordings. Thus, from **Study One**, we will use 71 White female patients and 92 White
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39 male patients who interacted with White male physicians. From **Study Two**, we will use the 34
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41 Black female patient/non-Black male physician dyads and 34 Black female patient/non-Black
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43 female physician dyads. Thus, within race concordant and race discordant interactions we will
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45 examine the effects of sex concordance and discordance. We acknowledge that this is not a full
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47 factorial design, but it will permit us to examine the influence of race concordance/discordance
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49 on nonverbal synchrony and, also partially examine whether the influence of race on nonverbal
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51 synchrony is moderated by patient and physician sex. To minimize any other differences
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3 between Black patients and White patients, we will also do block matching of patients from
4 **Study One** with patients from **Study Two** on characteristics that might affect nonverbal
5 communication (e.g., age, type of cancer). We expect this matching will reduce the number of
6 patients available from **Study One** by 20-30% percent, but sufficient cases will be available for
7 well-powered analyses of racial concordance/discordance. We will then further the equivalence
8 of patients with advanced methods of propensity scoring.⁹⁶⁻⁹⁸

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10 We will assess nonverbal synchrony in all matched interactions using customized Motion
11 Energy Analysis (<http://psync.ch/?p=9>)^{76,99} software to obtain synchrony scores for each
12 interaction. Figure 2 is a screenshot of the Motion Energy Analysis software. Motion Energy
13 Analysis is an objective automated method that continuously monitors the amount of movement
14 occurring in pre-defined regions of interest.^{62,76,100} Motion Energy Analysis captures frame-by-
15 frame movement and provides quantification of change in movement in the “regions of interest”.
16 In this study, we consider each individual as one “region of interest,” allowing us to capture full
17 body movement. Motion Energy Analysis uses pixel-differencing methods to measure total
18 amount of movement. We will quantify nonverbal synchrony by deriving scores using windowed
19 cross-correlation matrices to obtain synchrony scores for each interaction.¹⁰¹ Nonverbal
20 synchrony tends to ebb and flow during conversations.⁹¹ Windowed cross-correlation accounts
21 for the possibility of changing synchronization by comparing small sections of time at different
22 time lags. By looking at multiple smaller sections at multiple different lags, windowed cross-
23 correlation is able to estimate synchronization between systems which do not have a constant
24 lag. Figure 3 is windowed cross-correlation output displayed as a heat map with warmer colors
25 representing strong positive correlations between the two individuals’ behavior (e.g., positive
26 nonverbal synchrony) and cooler colors representing strong negative correlations (e.g., negative
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3 nonverbal synchrony). These synchrony scores are dyadic attributes that represent amounts and
4 relationships of synchronous movement within dyads. Once we have obtained these scores, we
5 will compare (a) effects of race concordance versus discordance on nonverbal synchrony and (b)
6 effects of sex concordance versus discordance on nonverbal synchrony, and (c) determine the
7 relative impact of race concordance/discordance versus sex concordance/discordance on
8 nonverbal synchrony.
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12 *Hypothesis 1: Nonverbal synchrony will be greater in racially concordant than in racially*
13 *discordant oncology interactions.* To obtain time-varying synchrony scores, we will block each
14 interaction into five equal segments and obtain synchrony scores for each segment using Motion
15 Energy Analysis. This procedure also allows us to adjust for patients and physicians moving
16 outside of the regions of interest set at the beginning of each segment and maximizes the
17 likelihood that we capture all patient and physician movement. For example, this strategy will
18 help us capture continuous movement even if a patient or physician gets up from a seated
19 position and walks outside of the pre-determined region of interest. To model changes in
20 dynamic and overall levels of synchrony, we will use structural equation modeling (SEM)
21 methods, latent differential equations (LDE), and multi-level modeling (MLM) methods. LDE is
22 a special case of SEM that allows for estimation of parameters of a proposed underlying
23 dynamical system. LDE models contain parameters pertaining to the dynamics of a given system
24 (e.g., “eta” and “zeta” parameters of a latent harmonic oscillator model). We will use multi-
25 group SEM modeling to test for differences in these parameters between racially concordant and
26 racially discordant interactions. By using a likelihood ratio test comparing two models where 1)
27 these dynamic parameters are free to vary and 2) where these parameters are constrained to be
28 equal across models, we will be able to determine if the motion dynamics differ between racially
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3 concordant and racially discordant interactions. Using a three-level HLM model with time
4 segments (level 1) nested within patient (level 2), and patient nested within physician (level 3),
5 we will model changes in nonverbal synchrony based on a categorical variable modeling either
6 racially concordant or racially discordant interactions. Assuming 168 dyads, an alpha of .05, a
7 correlation coefficient of .1, and a linear time effect, we have a power of .8 to detect an effect
8 size of .50.
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17 **Aim 2: Determine the influence of nonverbal synchrony on physician communication and**
18 **patient and physician affect in racially concordant and racially discordant oncology**
19 **interactions.** We will first collect the same observational measures for **Study One** as in **Study**
20 **Two**, including physician patient-centered communication and patient and physician affect, and
21 rapport. Trained research assistants will rate each of the racially concordant interactions on
22 physicians' patient-centered communication.⁴⁸ Next, we will create thin slices of the interactions
23 from **Study One** and naïve observers will rate the slices using the same measures of physician-
24 patient affect and rapport as in **Study Two**. Then we will use the synchrony scores from Aim 1
25 to compare the relationship between nonverbal synchrony and patient-physician affect and
26 rapport in racially concordant and discordant interactions.
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40 *Hypothesis 2: Nonverbal synchrony will influence physician patient-centered communication,*
41 *patient and physician affect, and relational rapport in racially concordant and racially*
42 *discordant clinical interactions.* We will use MLM and multi-group SEM to create a mediation
43 model where nonverbal synchrony will predict level-2 (patient) and level-3 (physician)
44 outcomes. Assuming 168 dyads, an alpha of .05, and a correlation coefficient of .1, we have
45 power of .8 to detect an effect size of .48.
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3 **Aim 3: Examine the antecedents and outcomes of nonverbal synchrony in racially**
4 **discordant oncology interactions.** We will achieve this aim using the synchrony scores from
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6 the racially discordant interactions in **Study Two**. We will examine the relationships between
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8 nonverbal synchrony and 1) interaction outcomes collected in the parent study including: patient
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10 satisfaction, distress, perception of physicians' patient-centered communication, and treatment
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12 expectations, and physician perceptions of the patient (e.g., willingness to follow treatment
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14 regimen), and 2) pre-interaction physician and patient race-related attitudes and perceptions (e.g.,
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16 implicit bias; suspicion), also collected in the parent study.
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21 *Hypothesis 3: In the racially discordant oncology interactions, nonverbal synchrony will*
22 *significantly negatively covary with patient post-interaction distress and positively covary with*
23 *1) patient post-interaction perceptions of physicians' patient-centered communication and*
24 *treatment expectations; 2) physicians' post-interaction perceptions of patient personal*
25 *characteristics (e.g., understanding of treatment options) and their responses to treatment (e.g.,*
26 *willingness to follow treatment regimen); and 3) observers' ratings of physician patient-centered*
27 *communication, patient and physician affect, and relational rapport. Using LDE, we will model*
28 *dynamic parameter values of the fluctuations in nonverbal synchrony over the course of each*
29 *interaction. These values will then be used as first-level predictors in an MLM model. The*
30 *second-level predictors for this model will be values associated with physician and patient post-*
31 *interaction perceptions of the interaction and of each other. Assuming 68 dyads, an alpha of .05,*
32 *and a correlation coefficient of .1, we have a power of .9 to detect an effect size of .56.*
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49 *Hypothesis 4: Nonverbal synchrony will significantly covary with pre-interaction race-related*
50 *attitudes and perceptions of the patient and physicians (e.g. physician implicit bias, patient*
51 *suspicion). We will create a three-level MLM. We will model synchrony assessed over five time*
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3 segments nested within each patient and each patient nested within physician. Each patient-
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5 physician dyad will have its own average synchrony score.
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8 **Aim 4: Develop and test a mediational model that links physician and patient race-related**
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10 **attitudes and perceptions to nonverbal synchrony and, in turn, outcomes of race-related**
11 **discordant oncology interactions.**
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15 *Hypothesis 5: Nonverbal synchrony will mediate the relationship between pre-interaction race-*
16
17 *related attitudes and perceptions and post-interaction perceptions of the patients and physicians.*
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19 To examine the proposed mediations in a multilevel context, we will utilize multi-level SEM, as
20 described by Preacher and colleagues.^{102,103} These models address potential conflated estimates
21 of mediated effects that can arise when using multi-level data. Time segments will be nested
22 within each patient and each patient will be nested within physician, with synchrony varying at
23 each time point. We will use a single mediation model to assess how physician and patient race-
24 related attitudes and perceptions influence interaction outcomes via their influence on nonverbal
25 synchrony.
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35 **Patient and Public Involvement.**

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37 Cancer survivors were heavily involved with both **Study One** and **Study Two**.
38 Investigators had extensive conversations with survivors about their experiences as patients and
39 survivors, which helped guide the research questions, measured outcomes, and design of both
40 studies.
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47 Patients were not directly involved with developing the research questions and outcomes
48 for this secondary analysis. However, this work extends naturally from the considerable previous
49 work we have done focused on understanding and improving patient-oncologist communication
50 for all patients, with special attention to patients more vulnerable to cancer treatment and
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3 mortality disparities. This secondary analysis will investigate another important aspect of patient-
4 physician communication that our patient and physician partners have agreed needs research
5 attention.
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10 Recruitment to both **Study One** and **Study Two** was done by the investigators and their
11 research and clinic staff. As PI, Dr. Hamel will disseminate results from this investigation
12 through the Karmanos Cancer Institutes' Department of Community Outreach and Education,
13 which has regularly scheduled meetings with cancer survivors, caretakers, and community
14 stakeholders.
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21 **ETHICS AND DISSEMINATION**

22 Studies one (069003B3D), two (125211B3E), and the current study (044716B3E) are all
23 approved by the Wayne State University Institutional Review Board. Only patients and
24 physicians from the previous studies who provided their consent for secondary analyses of their
25 data were included in the current study. The nature of the data makes it unlikely we will
26 encounter ethical or safety issues.
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35 We will submit our ongoing findings to relevant communication, social psychology, and
36 oncology conferences. Similarly, we plan to submit the final manuscripts to high-impact
37 communication, social psychology, and oncology peer-reviewed journals.
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42 **STRENGTHS AND LIMITATIONS**

43 This secondary analysis is innovative in its focus and method. This study explores nonverbal
44 synchrony, a channel of communication that has not been previously examined in medical
45 interactions. It takes advantage of existing datasets, which include video-recorded cancer
46 treatment discussions of Black and White patients with cancer, recorded with state-of-art
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3 recording equipment. It also applies automated behavioral coding software, thus introducing less
4 error than traditional methods using human coders.
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8 However, this study is not without limitations. First, this study takes advantage of
9 existing datasets, but the video-recorded and self-report data were not collected with the current
10 hypotheses in mind. Second, the data are not evenly distributed by sex and race. As is often the
11 case with medical research involving actual patients, the distributions of study patient
12 characteristics are constrained by the distributions of patient demographic and medical
13 characteristics of the patients that are treated at the participating hospitals. This reality precludes
14 us from fully examining all combinations of race and sex. However, there are advantages to the
15 fact that this research is conducted in a real-world, rather than a laboratory setting; also, we are
16 able to account for some variability in our models by treating certain factors (e.g., cancer type) as
17 random effects. Last, although given a design that is adequately powered to make both between-
18 and within-subject comparisons, it is still possible we may find no significant findings regarding
19 nonverbal synchrony. Of course, this finding would be interesting in and of itself and would
20 direct research attention to other avenues of investigation.
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40 **FIGURE LEGEND**

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42 Figure 1: Conceptual Model
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45 Figure 2: Motion Energy Analysis Software
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49 Figure 3: Window Cross Correlation Output
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REFERENCES

1. National Center for Health Statistics. *Health, United States, 2015: with special feature on racial and ethnic health disparities*. Hyattsville, MD, 2016.
2. Murphy CC, Harlan LC, Warren JL, et al. Race and insurance differences in the receipt of adjuvant chemotherapy among patients with stage III colon cancer. *J Clin Oncol*. 2015;33(23):2530-2536.
3. Bach PB, Schrag D, Brawley OW, et al. Survival of blacks and whites after a cancer diagnosis. *JAMA*. 2002;287(16):2106-2113.
4. Greenwald HP, Polissar NL, Borgatta EF, et al. Social factors, treatment, and survival in early-stage non-small cell lung cancer. *Am J Public Health*. 1998;88(11):1681-1684.
5. Ramsey SD, Howlader N, Etzioni RD, et al. Chemotherapy use, outcomes, and costs for older persons with advanced non-small-cell lung cancer: evidence from surveillance, epidemiology and end results-Medicare. *J Clin Oncol*. 2004;22(24):4971-4978.
6. Smedley BD, Stith AY, Nelson AR. *Unequal treatment: confronting racial and ethnic disparities in health care*. Institute of Medicine, 2003.
7. Tehranifar P, Neugut AI, Phelan JC, et al. Medical advances and racial/ethnic disparities in cancer survival. *Cancer Epidemiol Biomarkers Prev*. 2009;18(10):2701-2708.
8. Patel MI, Ma Y, Mitchell B, et al. How do differences in treatment impact racial and ethnic disparities in acute myeloid leukemia? *Cancer Epidemiol Biomarkers Prev*. 2015;24(2):344-349.
9. Ward E, Jemal A, Cokkinides V, et al. Cancer disparities by race/ethnicity and socioeconomic status. *CA Cancer J Clin*. 2004;54(2):78-93.
10. Ghafoor A, Jemal A, Ward E, et al. Trends in breast cancer by race and ethnicity. *CA Cancer J Clin*. 2003;53(6):342-355.
11. Jemal A, Siegel R, Ward E, et al. Cancer statistics, 2006. *CA Cancer J Clin*. 2006;56(2):106-130.
12. Siegel R, Ma J, Zou Z, et al. Cancer statistics, 2014. *CA Cancer J Clin*. 2014;64(1):9-29.
13. Hardy D, Liu CC, Xia R, et al. Racial disparities and treatment trends in a large cohort of elderly black and white patients with nonsmall cell lung cancer. *Cancer*. 2009;115(10):2199-2211.
14. Agency for Healthcare Research and Quality. 2014 National Healthcare Quality and Disparities Report. Rockville, MD, 2015.
15. Griggs JJ, Sorbero ME, Stark AT, et al. Racial disparity in the dose and dose intensity of breast cancer adjuvant chemotherapy. *Breast Cancer Res Treat*. 2003;81(1):21-31.

16. Morris AM, Billingsley KG, Hayanga AJ, et al. Residual treatment disparities after oncology referral for rectal cancer. *J Natl Cancer Inst.* 2008;100(10):738-744.
17. Berger M, Lund MJ, Brawley OW. Racial disparities in lung cancer. *Curr Probl Cancer.* 2007;31(3):202-210.
18. Daly B, Olopade OI. A perfect storm: How tumor biology, genomics, and health care delivery patterns collide to create a racial survival disparity in breast cancer and proposed interventions for change. *CA Cancer J Clin.* 2015;65(3):221-238.
19. Hayn MH, Orom H, Shavers VL, et al. Racial/ethnic differences in receipt of pelvic lymph node dissection among men with localized/regional prostate cancer. *Cancer.* 2011;117(20):4651-4658.
20. Penner LA, Eggly S, Griggs JJ, et al. Life-threatening disparities: the treatment of black and white cancer patients. *J Soc Issues.* 2012;68(2).
21. Meghani SH, Kang Y, Chittams J, et al. African Americans with cancer pain are more likely to receive an analgesic with toxic metabolite despite clinical risks: a mediation analysis study. *J Clin Oncol.* 2014;32(25):2773-2779.
22. Hassett MJ, Schymura MJ, Chen K, et al. Variation in breast cancer care quality in New York and California based on race/ethnicity and Medicaid enrollment. *Cancer.* 2015.
23. Phelan JC, Link BG. Is racism a fundamental cause of inequalities in health? *Annual Rev Soc, Vol 41.* 2015;41:311-330.
24. Jean-Pierre P, Fiscella K, Griggs J, et al. Race/ethnicity-based concerns over understanding cancer diagnosis and treatment plan. *J Natl Med Assoc.* 2010;102(3):184-189.
25. Eggly S, Harper FW, Penner LA, et al. Variation in question asking during cancer clinical interactions: a potential source of disparities in access to information. *Patient Educ Couns.* 2011;82(1):63-68.
26. Eggly S, Barton E, Winckles A, et al. A disparity of words: racial differences in oncologist-patient communication about clinical trials. *Health Expect.* 2015;18(5):1316-1326.
27. Gordon HS, Street RL, Jr., Sharf BF, et al. Racial differences in doctors' information-giving and patients' participation. *Cancer.* 2006;107(6):1313-1320.
28. Gordon HS, Street RL, Jr., Sharf BF, et al. Racial differences in trust and lung cancer patients' perceptions of physician communication. *J Clin Oncol.* 2006;24(6):904-909.
29. Siminoff LA, Graham GC, Gordon NH. Cancer communication patterns and the influence of patient characteristics: disparities in information-giving and affective behaviors. *Patient Educ Couns.* 2006;62(3):355-360.
30. Song L, Hamilton JB, Moore AD. Patient-healthcare provider communication: perspectives of African American cancer patients. *Health Psychol.* 2012;31(5):539-547.
31. Penner LA, Dovidio JF, West TV, et al. Aversive racism and medical interactions with black patients: a field study. *J Exp Soc Psychol.* 2010;46(2):436-440.
32. Boulware LE, Cooper LA, Ratner LE, et al. Race and trust in the health care system. *Public Health Rep.* 2003;118(4):358-365.
33. Nguyen GC, LaVeist TA, Harris ML, et al. Patient trust-in-physician and race are predictors of adherence to medical management in inflammatory bowel disease. *Inflamm Bowel Dis.* 2009;15(8):1233-1239.

- 1
- 2
- 3 34. Thompson HS, Valdimarsdottir HB, Winkel G, et al. The Group-Based Medical Mistrust
- 4 Scale: psychometric properties and association with breast cancer screening. *Prev Med.*
- 5 2004;38(2):209-218.
- 6
- 7 35. Bird ST, Bogart LM. Perceived race-based and socioeconomic status(SES)-based
- 8 discrimination in interactions with health care providers. *Ethn Dis.* 2001;11(3):554-563.
- 9
- 10 36. Bird ST, Bogart LM, Delahanty DL. Health-related correlates of perceived discrimination
- 11 in HIV care. *AIDS Patient Care STDS.* 2004;18(1):19-26.
- 12
- 13 37. O'Malley AS, Sheppard VB, Schwartz M, et al. The role of trust in use of preventive
- 14 services among low-income African-American women. *Prev Med.* 2004;38(6):777-785.
- 15
- 16 38. Green AR, Carney DR, Pallin DJ, et al. Implicit bias among physicians and its prediction
- 17 of thrombolysis decisions for black and white patients. *J Gen Intern Med.*
- 18 2007;22(9):1231-1238.
- 19
- 20 39. Hagiwara N, Penner LA, Gonzalez R, et al. Racial attitudes, physician-patient talk time
- 21 ratio, and adherence in racially discordant medical interactions. *Soc Sci Med.*
- 22 2013;87:123-131.
- 23
- 24 40. Cooper LA, Roter DL, Carson KA, et al. The associations of clinicians' implicit attitudes
- 25 about race with medical visit communication and patient ratings of interpersonal care. *Am*
- 26 *J Public Health.* 2012;102(5):979-987.
- 27
- 28 41. Blair IV, Steiner JF, Fairclough DL, et al. Clinicians' implicit ethnic/racial bias and
- 29 perceptions of care among Black and Latino patients. *Ann Fam Med.* 2013;11(1):43-52.
- 30
- 31 42. Hausmann LR, Myaskovsky L, Niyonkuru C, et al. Examining implicit bias of physicians
- 32 who care for individuals with spinal cord injury: A pilot study and future directions. *J*
- 33 *Spinal Cord Med.* 2015;38(1):102-110.
- 34
- 35 43. Hamel LM, Chapman R, Malloy M, et al. Critical shortage of African American medical
- 36 oncologists in the United States. *J Clin Oncol.* 2015;33(32):3697-3700.
- 37
- 38 44. Kirkwood MK, Kosty MP, Bajorin DF, et al. Tracking the workforce: the American
- 39 Society of Clinical Oncology workforce information system. *J Oncol Pract.* 2013;9(1):3-
- 40 8.
- 41
- 42 45. Cooper-Patrick L, Gallo JJ, Gonzales JJ, et al. Race, gender, and partnership in the
- 43 patient-physician relationship. *JAMA.* 1999;282(6):583-589.
- 44
- 45 46. Cooper LA, Roter DL, Johnson RL, et al. Patient-centered communication, ratings of
- 46 care, and concordance of patient and physician race. *Ann Intern Med.* 2003;139(11):907-
- 47 915.
- 48
- 49 47. Johnson RL, Roter D, Powe NR, et al. Patient race/ethnicity and quality of patient-
- 50 physician communication during medical visits. *Am J Public Health.* 2004;94(12):2084-
- 51 2090.
- 52
- 53 48. Street RL, Jr., Gordon H, Haidet P. Physicians' communication and perceptions of
- 54 patients: is it how they look, how they talk, or is it just the doctor? *Soc Sci Med.*
- 55 2007;65(3):586-598.
- 56
- 57 49. Elliott AM, Alexander SC, Mescher CA, et al. Differences in physicians' verbal and
- 58 nonverbal communication With black and white patients at the end of life. *J Pain*
- 59 *Symptom Manage.* 2016;51(1):1-8.
- 60
- 50 50. Penner LA, Gaertner S, Dovidio JF, et al. A social psychological approach to improving
- the outcomes of racially discordant medical interactions. *J Gen Intern Med.*
- 2013;28(9):1143-1149.

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 - 60
51. Penner LA, Dovidio JF, Gonzalez R, et al. The effects of oncologist implicit racial bias in racially discordant oncology interactions. *J Clin Oncol*. 2016;34(24):2874-2880.
52. Penner LA, Harper FWK, Dovidio JF, et al. The impact of Black cancer patients' race-related beliefs and attitudes on racially-discordant oncology interactions: A field study. *Soc Sci Med*. 2017;191:99-108.
53. Penner LA, Blair IV, Albrecht TL, et al. Reducing racial health care disparities: a social psychological analysis. *Policy Insights Behav Brain Sci*. 2014;1(1):204-212.
54. Hamel LM, Manning MA, Penner LA, et al. Racial attitudes and nonverbal convergence of patients and physicians in oncology interactions. Published Abstract from the Proceedings of the Society of Behavioral Medicine's Annual Meeting. *Annals Behav Med* 2017;51(1_suppl):S1742.
55. Richeson JA, Shelton JN. Brief report: Thin slices of racial bias. *J Nonverbal Behav*. 2005;29(1):75-86.
56. Dovidio JF, Kawakami K, Gaertner SL. Implicit and explicit prejudice and interracial interaction. *J Person Soc Psychol*. 2002;82(1):62-68.
57. Dovidio JF, Kawakami K, Johnson C, et al. On the nature of prejudice: Automatic and controlled processes. *J Exper Soc Psychol*. 1997;33(5):510-540.
58. Dovidio JF, LaFrance M. Race, ethnicity, and nonverbal behavior. In: Hall JA, Knapp M, eds. *Nonverbal Communication*. The Hague, The Netherlands: DeGruyter-Mouton; 2013:671-696.
59. Penner LA, Hagiwara N, Eggly S, et al. Racial healthcare disparities: a social psychological analysis. *Eur Rev Soc Psychol*. 2013;24(1):70-122.
60. Kimura M, Daibo I. Interactional synchrony in conversations about emotional episodes: A measurement by "the between-participants pseudosynchrony experimental paradigm". *J Nonverbal Behav*. 2006;30(3):115-126.
61. Condon WS, Ogston WD. Sound film analysis of normal and pathological behavior patterns. *J Nerv Ment Dis*. 1966;143(4):338-347.
62. Ramseyer F, Tschacher W. Nonverbal synchrony or random coincidence? How to tell the difference. *Development of Multimodal Interfaces: Active Listening and Synchrony*. 2010;5967:182-196.
63. Moulder RG, Boker SM, Ramseyer F, et al. Determining synchrony between behavioral time series: An application of surrogate data generation for establishing falsifiable null-hypotheses. *Psychol Methods*. 2018, epub.
64. Ramseyer F, Tschacher W. Synchrony: a core concept for a constructivist approach to psychotherapy. *Constructivism in the Human Sciences*. 2006;11:150-171.
65. Chartrand TL, Lakin JL. The antecedents and consequences of human behavioral mimicry. *Annual Rev Psychol, Vol 64*. 2013;64:285-308.
66. White K, Argo JJ. When imitation doesn't flatter: the role of consumer distinctiveness in responses to mimicry. *J Consumer Res*. 2011;38(4):667-680.
67. Chartrand TL, Maddux WW, Lakin JL. Beyond the perception-behavior link: The ubiquitous utility and motivational moderators of nonconscious mimicry. In: Hassin RR, Uleman JS, Bargh JA, eds. *The New Unconscious*: Oxford University Press; 2005:334-361.
68. Vacharkulksemsuk T, Fredrickson BL. Strangers in sync: achieving embodied rapport through shared movements. *J Exp Soc Psychol*. 2012;48(1):399-402.

- 1
2
3 69. Hove MJ, Risen JL. It's all in the timing: interpersonal synchrony increases affiliation. *Soc Cog*. 2009;27(6):949-960.
- 4
5 70. Miles LK, Griffiths JL, Richardson MJ, et al. Too late to coordinate: contextual
6 influences on behavioral synchrony. *Eur J Soc Psychol*. 2010;40(1):52-60.
- 7
8 71. Miles LK, Lumsden J, Richardson MJ, et al. Do birds of a feather move together? Group
9 membership and behavioral synchrony. *Exp Brain Res*. 2011;211(3-4):495-503.
- 10
11 72. Sacheli LM, Christensen A, Giese MA, et al. Prejudiced interactions: implicit racial bias
12 reduces predictive simulation during joint action with an out-group avatar. *Scientific
13 Reports*. 2015;5.
- 14
15 73. Paladino MP, Mazzurega M, Pavani F, et al. Synchronous multisensory stimulation blurs
16 self-other boundaries. *Psychol Sci*. 2010;21(9):1202-1207.
- 17
18 74. Wiltermuth S. Synchrony and destructive obedience. *Soc Influ*. 2012;7(2):78-89.
- 19
20 75. Wiltshire TJ, Steffensen SV, Fiore SM. Multiscale movement coordination dynamics in
21 collaborative team problem solving. *Appl Ergon*. 2018.
- 22
23 76. Ramseyer F, Tschacher W. Nonverbal synchrony in psychotherapy: coordinated body
24 movement reflects relationship quality and outcome. *J Consult Clinic Psychol*.
25 2011;79(3):284-295.
- 26
27 77. Valdesolo P, Ouyang J, DeSteno D. The rhythm of joint action: synchrony promotes
28 cooperative ability. *J Exp Soc Psychol*. 2010;46(4):693-695.
- 29
30 78. Macrae CN, Duffy OK, Miles LK, et al. A case of hand waving: action synchrony and
31 person perception. *Cognition*. 2008;109(1):152-156.
- 32
33 79. Miles LK, Nind LK, Henderson Z, et al. Moving memories: behavioral synchrony and
34 memory for self and others. *J Exp Soc Psychol*. 2010;46(2):457-460.
- 35
36 80. Albrecht TL, Eggly SS, Gleason ME, et al. Influence of clinical communication on
37 patients' decision making on participation in clinical trials. *J Clin Oncol*.
38 2008;26(16):2666-2673.
- 39
40 81. Eggly S, Hamel LM, Foster TS, et al. Randomized trial of a question prompt list to
41 increase patient active participation during interactions with black patients and their
42 oncologists. *Patient Educ Couns*. 2017;100(5):818-826.
- 43
44 82. Penner LA, Orom H, Albrecht TL, et al. Camera-related behaviors during video recorded
45 medical interactions. *J Nonverbal Behav*. 2007;31(2):99-117.
- 46
47 83. Riddle DL, Albrecht TL, Coovert MD, et al. Differences in audiotaped versus videotaped
48 physician-patient interactions. *J Nonverbal Behav*. 2002;26(4):219-239.
- 49
50 84. Dugan E, Trachtenberg F, Hall MA. Development of abbreviated measures to assess
51 patient trust in a physician, a health insurer, and the medical profession. *BMC Health
52 Serv Res*. 2005;5:64.
- 53
54 85. Greenwald AG, Nosek BA, Banaji MR. Understanding and using the implicit association
55 test: I. an improved scoring algorithm. *J Pers Soc Psychol*. 2003;85(2):197-216.
- 56
57 86. Jacobsen PB. Screening for psychological distress in cancer patients: challenges and
58 opportunities. *J Clin Oncol*. 2007;25(29):4526-4527.
- 59
60 87. Stewart M, Brown JB, Weston WW, TR. F. The impact of patient-centered care on
outcomes. *J Fam Pract*. 2000;49(9):796-804.
88. Ambady N, Rosenthal R. Thin slices of expressive behavior as predictors of interpersonal
consequences - a Metaanalysis. *Psychol Bull*. 1992;111(2):256-274.
89. Murphy NA. Using thin slices for behavioral coding. *J Nonverbal Behav*.
2005;29(4):235-246.

- 1
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 - 4
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 - 6
 - 7
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 - 10
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 - 47
 - 48
 - 49
 - 50
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 - 53
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 - 59
 - 60
90. Roter DL, Hall JA, Blanch-Hartigan D, et al. Slicing it thin: new methods for brief sampling analysis using RIAS-coded medical dialogue. *Patient Educ Counsel*. 2011;82(3):410-419.
91. Roter DL, Hall JA, Aoki Y. Physician gender effects in medical communication: a meta-analytic review. *JAMA*. 2002;288(6):756-764.
92. Janssen SM, Lagro-Janssen AL. Physician's gender, communication style, patient preferences and patient satisfaction in gynecology and obstetrics: a systematic review. *Patient Educ Couns*. 2012;89(2):221-226.
93. Schieber AC, Delpierre C, Lepage B, et al. Do gender differences affect the doctor-patient interaction during consultations in general practice? Results from the INTERMEDE study. *Fam Pract*. 2014;31(6):706-713.
94. Inglehart MR. Interactions between patients and dental care providers: does gender matter? *Dent Clin North Am*. 2013;57(2):357-370.
95. Bertakis KD, Azari R. Patient-centered care: the influence of patient and resident physician gender and gender concordance in primary care. *J Womens Health (Larchmt)*. 2012;21(3):326-333.
96. Iacus SM KG, Porro G. Causal inference without balance checking: Coarsened exact matching. *Political Analysis* 2012;20(1):1-24.
97. King GN, R. Why propensity scores should not be used for matching. *Working Paper*. 2016.
98. Austin PC. An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behav Res*. 2011;46(3):399-424.
99. *Motion Energy Analysis (MEA) [Computer software]*. [computer program]. Retrieved from <http://www.psync.ch2016>.
100. Ramseyer F, Tschacher W. Nonverbal synchrony in psychotherapy: Coordinated movement, the therapeutic relationship and outcome. *Internat J Psychol*. 2008;43(3-4):59-59.
101. Boker SM, Xu MQ, Rotondo JL, et al. Windowed cross-correlation and peak picking for the analysis of variability in the association between behavioral time series. *Psychol Methods*. 2002;7(3):338-355.
102. Preacher KJ, Zyphur MJ, Zhang Z. A general multilevel SEM framework for assessing multilevel mediation. *Psychol Methods*. 2010;15(3):209-233.
103. Preacher KJ, Zhang Z, Zyphur MJ. Alternative methods for assessing mediation in multilevel data: the advantages of multilevel SEM. *Structural Equation Modeling-a Multidisciplinary Journal*. 2011;18(2):161-182.

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 analyses.

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

1
2
3 SB: Co-Investigator, involved in all aspects of conceptualization and study design and
4 responsible for design and implementation of statistical analyses.
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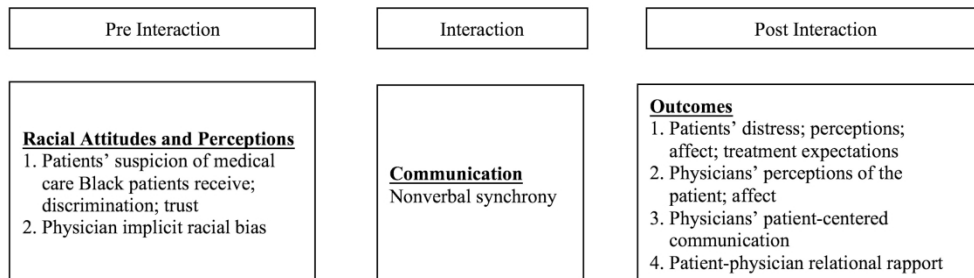
6 SE: Co-Investigator, involved in all aspects of conceptualization and study design.
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9 LAP: Co-Investigator, involved in all aspects of conceptualization and study design.
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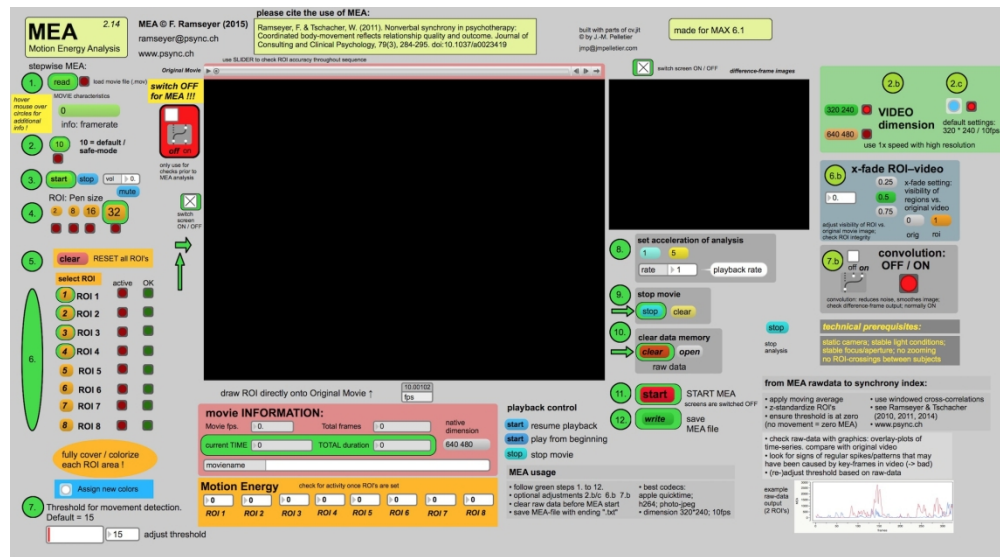
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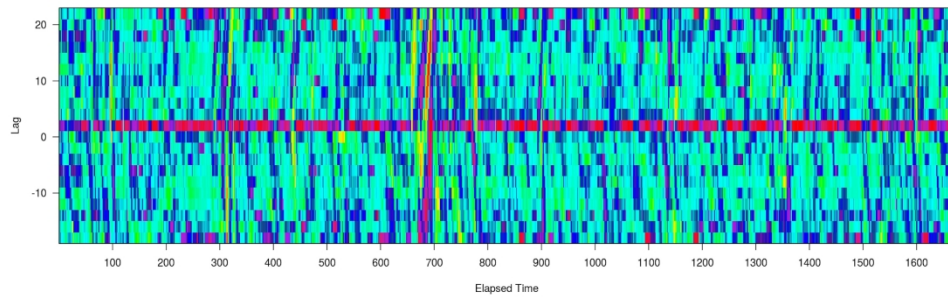
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262x76mm (300 x 300 DPI)



183x101mm (300 x 300 DPI)



252x76mm (300 x 300 DPI)