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Homophily Lens vs Rapport Lens

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Abstract: **Homophily is the tendency for people to associate disproportionately with others who are perceived to be similar. The term is used to explain phenomena in group socialization and agreement. This study was designed using the Perceived Homophily Measure (PHM) as a metric for measuring rapport in leadership socialization. Matching and mirroring (MM), a rapport-building tactic was tested quantitatively for its relationship to PHM. The study was grounded in the social identity theory, the social presence theory, the leader-member exchange theory, and the similarity-attraction paradigm. The quasi-experiment was conducted at Workforce Solutions North Texas in Wichita Falls using 2 groups. Participants in the test group, composed of employees and clients, conversed with an MM-coached candidate. Participants in the control group, composed of general public participants, conversed with an uncoached candidate from the general public. A post-test using the attitude homophily scale produced PHM as the dependent variable with MM as the independent treatment variable. Kinect® sensors detected joint-angle synchrony using specialized software to differentiate between the coached candidate and the uncoached candidate. It was assumed that the coached candidate would likely produce greater instances of synchrony. After adjusting for covariates of age, gender, ethnicity, height, eye-glasses, hobbies, and professions, no statistically significant difference was found between groups on PHM levels. It was determined that the use of two candidates weakened the study. Thus, further research was needed to determine the relationship between MM and PHM. Nevertheless, considering PHM as a metric for rapport inception represented a significant breakthrough in socialization metrics.**

Keywords: **homophily, rapport, metric, Kinect, matching, mirroring, socialization, leadership.**

I. TESTING MM USING PHM

A new unit of analysis was proposed in this study to represent the inception of rapport-like behavior. *Homophily*, the tendency for people to associate disproportionately with others who shared similar characteristics and viewpoints [1, 2, 3], was used to test the effects of *matching* and *mirroring* (MM) in face-to-face interactions [4], [5], [6], [3]. McCroskey and Richmond (1976) developed a Likert-type scale to determine levels of homophilous perceptions between people known as the Attitude Homophily Scale [3]. The Likert-type scale reliably measured homophilous perceptions with Cronbach's α = .88 and was an appositive fit for this study. PHM was thus proposed as a robust metric of social interaction considered rapport inception.

MM techniques were used in clinical studies in an attempt to create a connection with patients and later used in sales and socialization to establish rapport [4], [5], [6]. MM techniques involved cognitive vocal pace matching and body position (embodiment) mirroring between interlocutors (Hurley, 2008; Jacob, 2013; McGarry & Russo, 2011). The process seemed to create an interpersonal bond between employees and customers [5]. The rapport study was based observations of natural synchronic tendencies. Natural synchronic tendencies had been observed in various other studies [7], [8], [9]. Llobera et al. (2016) found that people, in a controlled environment, that performed actions together naturally synchronized with the development of rapport-like behavior. Thus, in this study, natural synchronic tendencies were contrasted with MM cognitive mirroring to determine its relationship to homophily levels.

II. QUANTIFYING RAPPORT

A. Leadership Socialization :

Quantifying rapport in leadership socialization strategies may help define the mechanics of transformational communication during the Leadership Succession Crisis in which 40 million baby boomers reach retirement age. The inability to quantify rapport places a greater strain on leadership retention by relying on qualitative observations to measure socialization effectiveness. Onboarding a new leader into an existing organization required rapport-building skills, whether coached or inherent, to gain legitimacy with the existing culture. Due to its strategic advantages in a global market, onboarding is expected to be the norm in the coming years as organizations seek new leadership [10], [11], 12]. Thus, new leaders replacing aging Baby Boomers, are expected to exercise transformational skills to lead the organization through the change event [10], a proposition that has been plagued with socialization challenges. Viewing the challenges using a rapport lens has not been an effective way of measuring outcomes in socialization strategies. The qualitative nature of rapport made the concept subjective and open to interpretation of social signals. By using homophily scores to quantify rapport inception, researchers can gain a better understanding of leader/member socialization using a homophily lens.

B. The Homophily Metric:

The use of homophily as a metric for rapport was a significant consideration for companies unprepared to meet the challenges of the Leadership Succession Crisis. *Onboarding* activities in the past focused on the managerial aspects of the leadership position [10], [13], [14], and thus relying on a new leader's abilities to gain legitimacy with the existing followership through socialization. MM was an ideal communication tactic to test against PHM levels as it had shown marked improvements in communication in past studies [13], [14], [15]. The data that resulted could help researchers gain a better understanding of rapport-building techniques as outcomes of homophilous perceptions in onboarding socialization strategies. A quantitatively tested communication tool could be a more reliable approach to the problem of onboarding socialization. The new leader could apply the tested tactics to free up time to focus on the managerial aspects of the position so that the company would not suffer downtime as a result of the transition.

III. THE QUASI-EXPERIMENT

In the first part of the experiment, the interaction of the treatment variable, matching and mirroring (MM), was either predicted to have no significant relationship or a significant one with elevated PHM levels. The null hypothesis ($H_0$1) for RQ1 thus predicted no significant relationship between MM and elevated PHM levels. In the context of socialization, elevated PHM levels were predicted to influence the selection of candidate choices. Whereas, the second null hypotheses ($H_0$2) predicted no relationship between elevated PHM levels and candidate choices.

A. Research Questions and Hypotheses

RQ1: To what extent, if any, is there a relationship between the application of MM processes and elevated PHM levels?

$H_0$1: There is no significant relationship between the application of MM processses and elevated PHM levels.

RQ2: To what extent, if any, is there a relationship between elevated PHM levels and positive candidate choices?

$H_0$2: There is no significant relationship between elevated PHM levels and positive candidate choices.

B. Measuring Homophily and MM

Past studies had shown various other stimuli that affected homophily levels such as age, gender, ethnicity, height, eye-glasses, hobbies, and professions [1], [2], [3]. An analysis of covariance (ANCOVA) allowed for these covariates to be included in the statistical equation. MM, the main independent variable, was partialed out in the equation, to observe its isolated effect on homophily scores. However, to differentiate between the two candidates would require hundreds of hours of observation to determine if one candidate was mirroring the other's body movements and positions (embodiments).

Kinect® sensors, in conjunction with Vitruvius® software, were used to record and track joint-angles formed between interlocutors to detect synchronic instances. The exported files in Excel® format contained joint-angles for the upper torso including computer time-stamping to observe moments of synchronization for comparison of joint angles between the pair. Figure 1 is an image of the Vitruvius® environment using Kinect® sensors. Table 1 shows the Excel® worksheets with the exported data from Vitruvius® and Kinect® sensors. The worksheets were compared between interlocutors to note moments of synchrony.

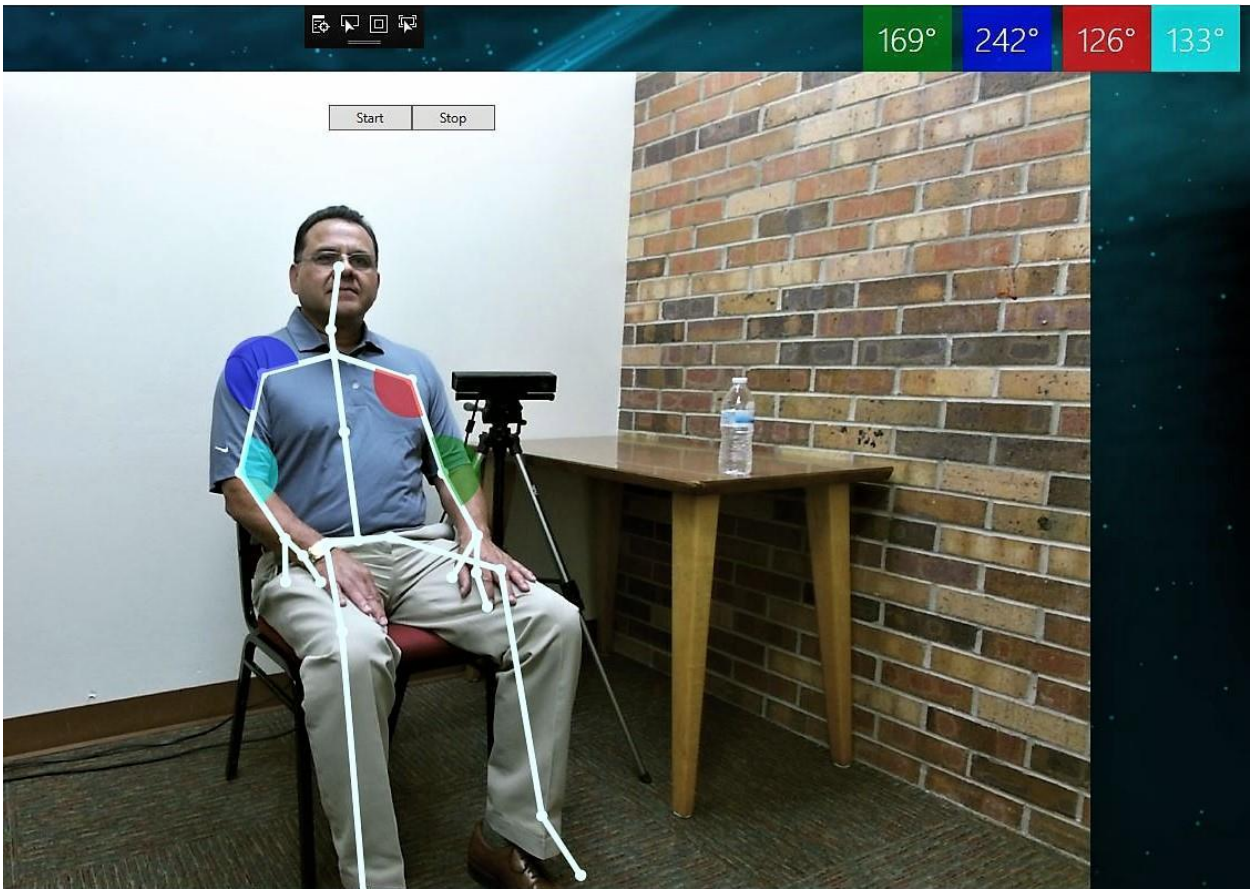

Fig. 1: Kinect® and Vitruvius® joint angle image. Kinect® skeletal mode detected distinct joint nodal configurations based on whether the person was standing or sitting. The arcs were differentiated by 4 different colors with joint angle calculations appearing on the upper right-hand corner of the screen. The data was exported into spreadsheet format for synchrony calculations. The photo of the UC was used with permission and a signed Release form.

TABLE 1: Excel Worksheet with Angle-Joint Figures

Time	ElbowRight	ShoulderLeft	ShoulderRight	ElbowLeft
2017-07-13-08-49-32-541	175	235	180	131
2017-07-13-08-49-32-606	174	234	180	130
2017-07-13-08-49-32-673	162	233	176	129
2017-07-13-08-49-32-739	128	232	155	128
2017-07-13-08-49-32-806	120	236	154	131
2017-07-13-08-49-32-874	191	238	156	130
2017-07-13-08-49-32-939	257	237	151	130
2017-07-13-08-49-33-018	270	244	139	134
2017-07-13-08-49-33-082	259	246	135	125

Note. Spreadsheet csv files were generated for each interlocutor to allow for computer time-stamped accuracy for calculating synchrony scores. Two Excel® worksheets were compared for synchrony measures within 10 degrees over or under.

Comparing two worksheets visually would have taken hundreds of hours of close observation with increased chances for error. DiffEngineX®, stand-alone software for Excel® sped up the process exponentially with fewer chances for error. Worksheet comparisons using value ranges for each cell greater than 15 degrees were highlighted, leaving synchrony measures un-highlighted. Time-stamping contained similar data in both spreadsheets. Only data referring to joint angles were compared and highlighted after data normalization. Joint angles within 15 degrees over or under were left un-

highlighted to indicate embodiment synchronization. Synchrony lasting 5 seconds or longer scored a one point in accordance with Tschacher and Ramseyer (2014) who described the *social present* as a 5-second moment of synchrony. This moment was hypothesized to be the inception point of a social bond between interlocutors. However, embodiment synchrony only accounted for one part of the total MM score. The second part of the process involved matching the rate of speech (ROS), also known as vocal pace.

ROS matching required specialized software to detect peaks in the recorded audio signals during conversation. Praat 6.0.28® was developed by Boersma (2002), a phonetic scientist at the University of Amsterdam. The Praat® environment facilitated the detection of the syllable nucleus [16] by converting audio signals into a three-tier window showing a two-channel, Mel-Frequency scale in Tier 1; a spectrograph in Tier 2, and; syllable nuclei calculations in Tier 3. Tier 3 was designed to automatically calculate syllable nuclei [16]. However, volume affected the intensity of the recorded signals and lower-volume voiced sections were interpreted as silence. When voiced sections were too low to be detected by the syllable nuclei feature, Tier 2 was used to estimate syllables per second by counting the voiced indicators in the spectrograph. A sensitive microphone between interlocutors may have been more effective in recording the conversations rather than relying on the Kinect® sensor environment.

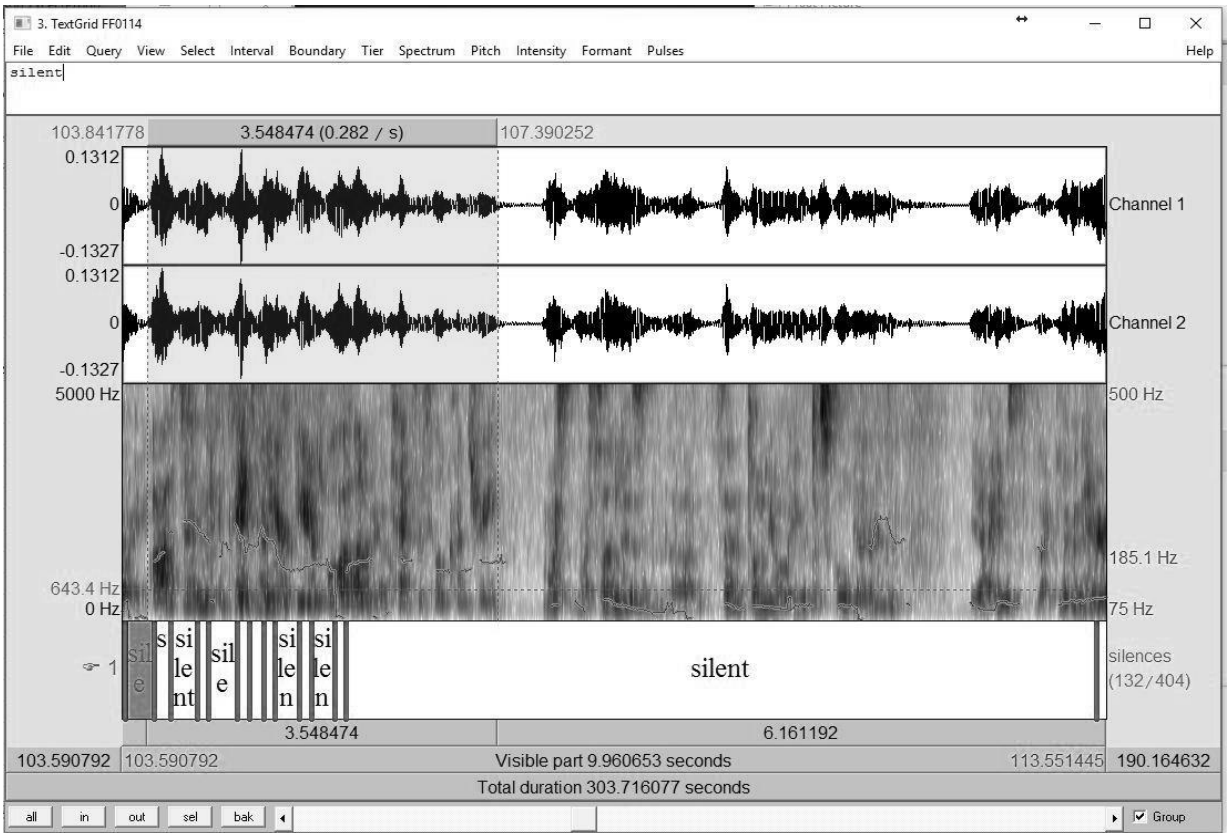

Fig. 2: **Praat® syllable nuclei frequency per second.** Praat® generated a Text/Grid for each session separating signals into 3 tiers. The top tier contained a Mel-Frequency scale; the middle tier contained a spectrograph, and; the bottom tier indicated syllable nuclei. Some low-volume voiced signals were detected as silence making it necessary to use the spectrograph to calculate syllable nuclei per second.

Score calculations were transferred to Excel® files to calculate ROS. Table 2 is an example of the calculations used as the conversation progressed. Vocal bursts by both interlocutors were highlighted to measure syllable nuclei per second (ROS). The participants were identified by codes rather than personal names to protect privacy. Candidates were indicated by either CC or UC. The *Start* and *End* columns indicated conversational bursts starting at a specific time during the conversation. The calculated total syllables from the Praat® software environment were entered into the "Total Syl" column. Referring to the first line in Table 2, the conversational burst began at 64.26 seconds into the conversation. The burst lasted approximately 4 seconds ending at 68.25 seconds. Thus (68.25 – 64.6) ÷ 14 Syl = 3.50877 syllables per second. Means were compared within an approximate one-minute frame. Scores at the end of one minute within 5% of ROS totals scored a 1.

TABLE II: ROS CALCULATIONS AND SCORING

Time			ROS	
Start	End	Total Syl	FF0209	CC
64.26	68.25	14		3.50877193
73.35	75.76	9	3.734439834	
81.57	84.24	9		3.370786517
85.34	91.6	16		2.555910543
93.47	96.41	10		3.401360544
96.68	98.24	7		4.487179487
99.36	105.75	23	3.599374022	
107.75	114.14	21	3.286384977	
114.68	118.08	12	3.529411765	
		Mean	3.537402649	3.464801804
		Score:	1	

Note. The calculations in Excel® accounted for vocal bursts separated between interlocutors within a specific time-frame. ROS attributed to participants were coded, indicating female (F) number 9 (09) in the test group (02), during the pilot study (F). Mean syllables per second were calculated and compared between participant and coached candidate (CC) or uncoached candidate (UC). Syllable nuclei per second calculated within 5% of each interlocutor scored 1 point.

C. Analyses

An analysis of covariance (ANCOVA) was used to compare variance between PHM scores and MM scores from Kinect® sensors while taking into account the covariates for both groups. Covariates were identified as age, gender, ethnicity, height, glasses, hobbies, and professions. The covariates were scored based on whether the CC or UC shared the covariate in common. If a covariate was not common it was indicated with the number 0. If a covariate was common, the number 1 was used. MM scores ranged from: 0 to 2 = 0; 2.1 to 10.0 = 1; 10.1 to 20.0 = 2; 20.1 to 30.0 = 3; 30.1 to 40 = 4; 40.1 to 50 = 5, and; 50.1 to 60 = 6. The variance of synchrony ranges were compared with the variance of scaled PHM scores to determine if a relationship existed between the two, accounting for the covariates of age, gender, ethnicity, height, corrective lenses, hobbies, and professions.

D. Control Group Demographics

Control group participants ranged from ages 19 to 63; with 65% White Caucasian, 5% African-American, 25% Hispanic or Latino, and 5% Native American; with 52% male and 48% female. The uncoached candidate, a Hispanic male, age 55, with a 5'6" height, shared common covariates with some of the research participants. Other demographic characteristics that could have influenced homophilous perceptions such as attire did not appear to influence viewpoints due to other mitigating characteristics such as skin tone and age differences.

E. Test Group Demographics

Test group participants ranged from ages 21 to 69; with 65% White Caucasian, 3.3% African-American, 25% Hispanic or Latino, 3.3% Native American and 3.3% Japanese; with 24% male and 76% female. The coached candidate at age 57 shared a common age range with 3 of the participants; a common height range with 9 participants; a common ethnicity with 4 participants and; glasses with 10 participants. The commonalities indicated that the particular covariate would be included in the analysis.

F. Findings

After adjusting for all the covariates, there was not a statistically significant difference in PHM levels as produced by MM processes between groups, F (1,18) = 1.422, p = .249, partial $\eta 2$ = .073, failing to reject the first null hypothesis ($H_0 1$). ANCOVA was rerun to test the 2nd null hypothesis ($H_0 2$) regarding candidate choice. The results indicated a significant relationship between candidate choices and PHM, F (2,22) = 7.440, p = .003, thus resulting in rejection of the second null hypothesis ($H_0 2$). However, since both groups produced similar choice points, there was no differentiation between groups.

Failing to reject the first null hypothesis did not necessarily mean that MM processes had no effect upon homophilous perceptions. Other factors may have contributed to the outcome as well. For example, the CC and the UC, although matched for conspicuous characteristics, were not matched for personality and mannerisms which probably affected PHM levels as well. This was one of the limitations of the study accepted for generalization. This strategy was meant to account for applicability in leadership socialization. However, functionality should have been the focus. Additionally, the low partial $\eta 2 = .073$ indicated that the sample size was probably too small for this particular population.

The rejection of the second null hypothesis indicated that PHM levels correlated with acceptance levels. However, acceptance levels were evenly distributed between groups indicating that, although choice affected PHM levels, the differentiation between groups was not significant. Since PHM levels were similar between CC and UC, the outcome simply indicated a relationship between homophilous perceptions and coworker acceptance; a relationship confirmed in other studies [17], [18], [19]. If PHM levels had varied between groups it is possible that the outcomes would have shown a difference in this category as well. Nevertheless, further research was required to ascertain the difference between higher and lower PHM levels and *choices* as differentiated between groups.

IV. RECOMMENDATIONS

A significant relationship between PHM levels and MM processes was not established. However, the quantitative environment posed many challenges due to inherent complexities in identifying and observing embodiment and vocal synchrony. It was apparent that the structure of the test could have been improved in various ways. The newness of utilizing a quantitative approach to social interaction required development and improvements in the test structure. As such, communication researchers should seek ways of altering the structure of the experiment that may help to identify the true MM effect. Altering the experiment by using one candidate would remove all confounds.

The tools required to differentiate an MM coached candidate from a normal candidate were high technology instruments that continue to be in development such as Kinect® sensors [17], in conjunction with Vitruvius® software. These instruments were new to academia as differentiating tools in social exchanges. The technology presented additional challenges due to differences in computer hardware. The need for using two separate computers possibly created synchronization issues on differentiation. Developmental research may improve Kinect® sensors in the future to allow for the operation of two sensors on one computer.

The attitude homophily scale was tested for reliability in this study as it had been tested in other studies [3]. The scale was shown to have high reliability with Cronbach's $\alpha = .88$ which confirmed previous measures. However, the final item added to the scale was designed to determine coworker choice. The item was not tested for reliability and thus represented a weakness in the study. A separate *choice* Likert-type scale may have provided more accurate data.

Additionally, researchers in the future should consider clinical relevance rather than statistical significance in the study. Clinical relevance may apply when considering matching and mirroring as an intervening treatment variable between groups. Although clinical relevance was more often used in healthcare studies, the methodology may be applicable. Distribution-based methods for approximating clinical relevance such as repeated measures for effect size can determine the strength of the relationship between the dependent and the independent variables. Cohen's *d*, is a popular measure that could be used. The process involves taking the difference between the means of two groups and dividing that difference by the pooled standard deviation. Clinical relevance, however, would be a unique way of approaching social data explored in future studies.

V. CONCLUSION

For years communication researchers have sought to find an appositive metric for rapport in an effort to quantify human relationships and to engage in empirical studies that confirm effectiveness [17], [18], [19], [20]. However, the concept of rapport seemed to encompass a host of indicators due to its qualitative characteristics. Researchers often replaced rapport with trust [18], [21], [22], [23]. Although the comparison had some merit, trust was often developed from perceptions of status or experience and not necessarily from face-to-face communication. Synonymizing rapport with other parallel perceptions such as *empathy* provided additional challenges. When the perception of one person was aligned with another emotionally, the level of understanding increased, thereby promoting prosociality [21], [22], [23]. However, the perception of empathy, like rapport, had been fodder for debate as to its substance and purpose [21], [27], [26]. Measuring empathy was as much a challenge as measuring rapport. Nevertheless, *empathy* was grounded with the concept of homophily in that empathic signals likely created commonality perceptions in both parties.

Homophily, rather than *empathy* or rapport, was proposed in this study as the binding agent required for leadership socialization. The measuring instrument for PHM, the attitude homophily scale, was created and improved for reliability in past studies [3]. The scale was used with expressed permission from the copyright holder, Lynda McCroskey. Investigation into the relationship between the communication tactic, MM and PHM was essentially exploratory. Any communication tactic or rapport-building strategy could have been tested using PHM as a metric. However, MM closely paralleled theories aligned with homophily, such as the social identity theory, the social presence theory, the behavioral integration theory, and the similarity-attraction paradigm. The mirror neuron theory may have had some applicability but will require further research.

Although MM and PHM levels were not shown to have a significant relationship, future research using alternate methodologies and experimental structures was advised. Many researchers have concluded indications of rapport with synchronic movement between interlocutors [21], [22], [23], [24], [7], [25]. Thus outcomes in this study merit further investigation into the relationship between rapport-building tactics and homophily levels.

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