Overcoming Barriers to Physical Activity in People with Osteoarthritis: The Role of Empathic Accuracy in Couples' Planning Discussions

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Abstract

Background

Osteoarthritis (OA) is a common chronic joint disease with significant individual and public health consequences. Physical activity can reduce OA symptoms, but patients often fall below recommended levels. Social support from an intimate partner can help them become more active; however, some couples are better than others at enacting effective support.

We examined the role of empathic accuracy (EA) – the ability to understand another person's thoughts and feelings – in couples' ability to identify strategies for overcoming barriers to increasing activity. We also examined whether EA was associated with changes in affect and with emotion regulation and communication skills.

Methods

Forty-two insufficiently physically active participants with OA identified a barrier to becoming more active in a recorded discussion with their partner. Next, both rated self and partner thoughts and feelings during the discussion. Raters coded EA and whether discussions reached a solution. Affect and skills were assessed with validated questionnaires.

Results

An actor-partner interdependence model found higher EA for participants in couples who reached a solution compared to those who did not reach a solution in the allotted time. Both partners' EA was associated with reduced negative affect in the other member of the couple. Unexpectedly, EA in people with OA was associated with reduced positive affect for their partners. EA was positively associated with one skill: emotional clarity.

Conclusions

Findings from this early-stage study suggest that EA can help couples manage health-related issues together. Emotional clarity emerged as a skill related to EA, suggesting avenues for additional research.

Osteoarthritis (OA) is a chronic, degenerative joint disease that causes joint pain, stiffness, and loss of function, primarily in middle-age and older adults. It affects an estimated 27 to 31 million people in the United States [1]. In addition to increasing physical and mental health problems in individuals [2,3], OA is a major public health concern that contributes to increased use of pain medications, physician visits, hospitalization, and surgery [3,4]. Given the scope of its impact, even small improvements in the health and well-being of people with OA can have a substantial impact on individual and public health.

A strong consensus supports multimodal therapies for OA, and increased physical activity is a central component of these therapies [5]. Light to moderate physical activity reduces joint symptoms and improves functioning and mental health in people with OA [6–8]. Yet, most people with OA do not meet recommended levels of physical activity [9].

Physical activity interventions help people obtain the benefits of an active lifestyle, usually by educating them about why they should become more active and how they can do so, in addition to increasing their confidence in their ability to become more active. Researchers also recognize that, outside of interventions, social support from significant others can promote these critical changes in knowledge, beliefs, and behavior through encouragement, information, and tangible assistance for increasing physical activity.

A spouse or intimate partner is particularly well-positioned to influence lifestyle health behaviors in these ways [10,11]. However, giving and receiving social support for a lifestyle change requires that members of a couple make complex decisions about when and how to provide and solicit support and how to manage support attempts that are not optimally helpful because they are not a good fit for the recipient's needs [12]. In fact, research in people with knee OA illustrates how different strategies for influencing another person's physical activity can either promote or hinder behavior change [11]. Martire and colleagues

found that when men and women with OA perceived that their spouse provided greater autonomy support for physical activity (e.g., showing understanding, respecting decisions), they engaged in more physical activity, whereas when male participants with knee OA perceived that their partner used greater activity-related pressure to get them to be more active (e.g., nagging, criticism), they engaged in less physical activity. We propose that some couples are better able than others to navigate complex interpersonal decisions related to providing and soliciting informational, emotional, and task support that facilitates behavior change. For instance, some support providers have better skills than others for avoiding forms of support likely to be perceived as negative and instead providing useful advice or guidance; emotional support that communicates caring, encouragement, and reassurance; and instrumental support that removes barriers to change.

We further propose that an important underlying capability that enables these effective forms of social support for physical activity is empathic accuracy. Empathic accuracy is the ability to accurately infer another person's moods, emotions, thoughts and other mental states [13]. Previous research has demonstrated that empathic accuracy is associated with better support provision in romantic couples [14] and with more overall relationship satisfaction [15].

On the other hand, there are situations in which empathic accuracy might be detrimental, such as in conflict situations; Simpson, Ickes and Blackstone [16] have shown that when couples are in conflict about their relationship, high levels of accuracy might be associated with worse relationship outcomes and even separation. The authors suggest that participants with greater empathic accuracy identified negative thoughts and emotions that their partners had about the relationship, whereas less accurate ones remained optimistic. A recent daily diary study [17] has shown that participants who accurately perceived their partner's emotions during conflict experienced their partners as less responsive. At the same

time, their partners experienced them as *more* responsive, suggesting that during conflict, empathic accuracy was beneficial to its target while being detrimental to the perceiver. These findings indicate the potential complexity of effects of empathic accuracy and the need for additional research to advance understanding of this important interpersonal skill.

As empathic accuracy was found to be beneficial in some contexts and detrimental in others, the current study sought to examine the effects of empathic accuracy on couples attempting to deal with one partner's health issue together. Specifically, we looked at a recorded conversation in which couples tried to jointly develop a strategy for overcoming a barrier to physical activity identified by the member of the couple who was affected by OA and insufficiently physically active. Although there is much research on empathic accuracy in couples, to the best of our knowledge there is no previous research on empathic accuracy in couples reaching decisions about how to manage OA or how to manage chronic illness in general.

Hypothesis 1. Following research on the association between empathic accuracy and social support, we hypothesized that both partners' empathic accuracy would be associated with better resolutions of discussions on overcoming a barrier to increasing physical activity, as rated by external coders.

Hypothesis 2. Following research on effects of empathic accuracy on targets and perceivers, we expected empathic accuracy to be associated with more positive and less negative affect for the targets, and less positive and more negative affect for the perceivers.

In addition, we examined whether empathic accuracy was associated with specific interpersonal and emotional skills that we propose are important for sensitive, productive problem-solving discussions in these couples. Emotional intelligence research has shown associations between such skills and more effective support provision and relationship

functioning [18,19] in couples dealing with chronic illness [20]. There is relatively little research on the interplay between these skills and empathic accuracy. As an initial attempt to address this gap in the literature, we chose to focus on two types of skills for which we could find some indication of a link to empathic accuracy – emotion regulation and communication. First, Zaki and Williams [21] suggest that emotion regulation skills might be associated with empathic accuracy because they can help partners tailor their use of specific interpersonal emotion regulation strategies to demands of a specific situation. Second, empathic accuracy is considered to be an integral part of nonverbal communication [22] and has been shown to be associated with better communication in general in studies on conflict resolution [23,24].

Exploratory Analysis. We expected empathic accuracy to be positively associated with emotion regulation and communication skills; however, as there is not much existing literature on this question, we regard this hypothesis as exploratory.

Methods

Participants

Participants with OA were recruited using four separate methods – through a university-wide recruitment e-mail, through a university-affiliated website posting research opportunities, and through the university-affiliated medical center's medical database. Although these channels reach a large and diverse population of older adults, we also attempted to recruit participants in the community directly by organizing in-community presentations on the importance of physical activity for people with OA and introducing the study during these presentations.

Inclusion criteria required that individuals self-report a diagnosis of OA or that they had likely OA (i.e., symptoms in one or both knees or hips and age 40 years or older, to maximize the likelihood that symptoms would be due to OA). They had to be insufficiently

physically active (<150 minutes of moderate to vigorous physical activity per week) but able and interested in increasing their physical activity. To ensure that it was medically appropriate for them to increase their physical activity, we required participants with OA to be able to walk unaided and to not require medical supervision during physical activity. Participants were excluded from participation if they had uncomplicated knee or hip surgery in the last 6 months or complicated surgery in the last 12 months. Finally, they were required to be married or in a marriage-like relationship with a cohabiting partner who was willing to participate in the study. Couples in which both partners met inclusion criteria could select which partner was considered the "main" partner (i.e., the one asked to discuss barriers to increasing physical activity during the study). Initially, participants were compensated $50 each ($100 as a couple) for participation; during our recruitment period we increased compensation to $150 per couple due to slow recruitment.

One hundred and twenty-eight couples entered the screening process. Of those, 20 did not complete the online screener, and 57 others were excluded from the study. The main causes for exclusion were having symptoms which were not severe enough (14 participants), already being physically active for more than 150 minutes a week (13 participants), not being able to walk unaided (8 participants), and having severe unrelated health issues (e.g, heart conditions which are not controlled well by medication; 8 participants). Nine of the 51 remaining couples declined participation, and 42 couples were enrolled and completed the full protocol. The number of participants in each phase is detailed in Figure 1.

In 30 out of 42 couples (71%), the person with OA was female. Mean age was 64.1 (*SD* = 9.4) for people with OA and 63 (*SD* = 11.3) for partners. Mean relationship length was 30.4 years (*SD* = 17.1). In 78.6% percent of couples, both participants had a 4-year college degree or better; in all other couples both partners did not. Couples' median annual household

income fell between $75,000 and $89,000. Three couples were female same-sex couples, the other 39 couples were mixed-sex.

Procedure

Participants were invited to the lab for a 2-3 hour visit to complete study activities. Each visit was conducted by 2-3 trained staff members. After providing informed consent, the couple was separated to complete a baseline questionnaire in different rooms. The questionnaire directed the person with OA to provide a written description of a barrier to engaging in physical activity. Then, both participants were escorted to the main study room in which two video cameras were set up, each focusing on one of the participants' faces. As a warm-up activity, participants were instructed to pick an object from a basket we provided and to work together to describe the object without naming it. This activity was limited to 2 minutes.

Afterwards, the staff members administered a modified version of the dyadic interaction paradigm [25]. The couple had a 5-minute discussion about the barrier to physical activity identified by the person with OA. Using scripted instructions, the staff instructed couples to come up with one or two solutions to overcome the barrier. The instructions strongly encouraged both members of the couple to contribute to the conversation. After five minutes, the discussion was ended and each member of the couple was escorted to a different room where they independently completed a brief post-interaction questionnaire. Next, a staff member used scripted instructions to describe the empathic accuracy procedures and then began the empathic accuracy task. Participants watched the video of their own face, recorded during their discussion with their partner. They were instructed to stop the recording at any time they remembered experiencing a specific thought or feeling and to write that thought or feeling on a form. Next, they watched the video of their partner's face during the discussion.

The staff member stopped the recording at the moments in which their partner had indicated experiencing a thought or feeling. Participants were instructed to record what thought or feeling they believed their partner experienced at each of these moments. The study ended after each member of the couple independently completed a final questionnaire. Couples were then thanked and debriefed. All procedures were approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

Measures

Empathic Accuracy. Empathic accuracy was coded using the coding scheme outlined by Ickes et al. [25]. For each moment in which a participant tried to infer their partner's thought or feeling, their inference was rated 0 (not similar at all), 1 (somewhat similar), or 2 (essentially identical) to the thought or feeling self-reported at that moment by their partner. Four coders were trained to complete these ratings. First, they each independently coded a random sample of responses provided by 20% of couples. Next, they reviewed their ratings as a group to discuss disagreements, with the goal of increasing consistency in their use of the rating system. Finally, the coders independently coded the remaining discussions assigned to them. Inter-rater reliability when rating the subset of 20% of the discussions was kappa .480- .597 (mean: .545). As this is slightly low, the four coders then rated all of the discussions and scores were averaged to obtain the final ratings.

We then computed an EA score for each participant by dividing the sum of ratings for each participant by the maximum possible rating for that participant (the number of statements times 2), and multiplying the result by 100 to achieve a score ranging from 0 to 100. As the final results are on a ratio scale, and as all discussions were rated by all judges, we could measure internal consistency using ICC for mean raters, which was very high (ICC = .91, 95% CI .89,.92).

Discussion outcome. Each discussion was coded on a 1-5 scale: 1 (*solution reached*) indicated the couple reached one or more solutions; 2 (*on track*) indicated the couple discussed solutions and seemed to be moving toward agreement on one or more, but did not agree on one in the allotted time; 3 (*solution unclear*) indicated the couple discussed solutions, but it was unclear if they were moving towards an agreed upon solution; 4 (*no solution*) indicated the couple discussed one or more solutions but did not reach a clearly formed solution at the end of their discussion (e.g., they spent the discussion discussing the barrier or rejecting possible solutions); and 5 (*off topic*) indicated the couple did not discuss solutions. All discussions were coded by two coders (CR and SB). They developed the coding scheme through an iterative process, soliciting feedback from other collaborators as needed, then coded each discussion separately. Inter-rater reliability was high (kappa = .81). In cases of disagreement, they discussed their coding until a consensus was reached.

Beyond treating outcome as a categorical variable, we also ran exploratory analyses coding outcome as a single variable coded from 1-3 with "solution reached" coded as 3, "no solution" coded as 1 and all other outcomes coded as 2[1]. While this analysis might have more power than a categorical one, we define it as exploratory as there are many other ways to group the categories into one variable (e.g., "off topic" could plausibly be assigned a lower value than "no solution"). As we could not theoretically justify our specific grouping, which was decided upon after we knew the results, this analysis carries some risk of researcher bias.

Affect. Positive and negative affect were measured by the Positive and Negative Affect Schedule [PANAS; 26], which asks participants to rate the extent to which they feel 20 emotions on a 5-point Likert-Type scale. Ten items were summed to create a positive affect scale, and the other ten items were summed to create a negative affect scale. The measure

[1] We wish to thank an anonymous reviewer of a previous version of the manuscript for suggesting this analysis.

was administered both before and after the discussion; analyses were performed on the post-discussion measures, with pre-discussion measures included to control for baseline affect. Positive affect reliability (i.e., internal consistency) was .89 for people with OA and .92 for partners at baseline, and post-discussion it was .91 for people with OA and .91 for partners. Negative affect reliability was .77 for people with OA and .72 for partners at baseline, and post-discussion it was .69 for people with OA and .89 for partners.

Communication Skills. Communication skills were measured at baseline using the Accommodation Scale [27], which includes 32 statements that participants rate true or false. The measure includes two subscales. The problem-solving subscale includes 19 items (e.g., "When my partner and I have differences of opinion, we sit down and discuss them"). For this subscale, Cronbach's alpha was .86 for people with OA and .83 for partners. The affective communication subscale includes 13 items (e.g., "I feel free to express openly strong feelings of sadness to my partner"). For this subscale, Cronbach's alpha was .83 for people with OA and .77 for partners.

Emotion Regulation Skills. Emotion regulation skills were measured using the Trait Meta-Mood Scale [28], which consists of 30 statements, each scored on a 6-point Likert scale (1=strongly disagree to 6=strongly agree). The scale has three subscales. The attention to feelings subscale includes 13 statements (e.g., "I pay a lot of attention to how I feel"). Cronbach's alpha was .72 for people with OA and .62 for partners. The clarity of feelings subscale includes 11 statements (e.g., "I am often aware of my feelings on a matter"). Cronbach's alpha was .76 for people with OA and .80 for partners. The mood repair subscale indicates the extent to which participants try to improve their own feelings. It includes 6 statements (e.g., "When I become upset I try to remind myself of all the pleasures in life"). Cronbach's alpha was .57 for people with OA and .59 for partners, indicating low reliability for this subscale.

Statistical analysis

In analyses conducted to test hypotheses, we modeled the association between several independent variables and participants' empathic accuracy, which served as the dependent variable in the analysis. To examine the dyadic data, we used analyses that applied the actor-partner interdependence model [APIM; 29], which accounts for interdependence between dyadic variables (e.g., reports of empathic accuracy by both people within a given couple, which are correlated). Each model included both the main partner, which we designated "person with osteoarthritis" (PWOA), and the other partner which we designated "support provider". These individual participants were nested within couples to account for interdependence. For each hypothesized association, we estimated both the actor effect and a partner effect. The actor effect is the effect of a participant's independent variable on their own dependent variable (e.g., the effect of the person with OA's emotional clarity on the person with OA's empathic accuracy or the effect of the support provider's emotional clarity on the support provider's empathic accuracy). The partner effect is, within each couple, the effect of one participant's independent variable on the other participant's dependent variable (e.g., the effect of the support provider's emotional clarity on the person with OA's empathic accuracy or vice versa).

Following recommendations for APIM analyses [29], data were treated as repeated measures data with two data points for each couple, each representing one of the individuals within a couple. Importantly, this means that although an APIM analysis increases the number of variables by including each variable twice (once as an actor variable and once as a partner variable), it also includes data from each couple twice to compensate.

The models were estimated with mixed linear regression performed using the R nlme package [30]. For Hypothesis 1, the outcome of each couple's discussion was the same for

both members of the couple, and thus the independent variable represented the couple's discussion outcome. For Hypotheses 2 and 3, for each independent variable we included both the person with OA's and the support provider's version.

To evaluate whether participant role (person with OA versus support provider) affected associations between empathic accuracy and other variables, each analysis also included a "role" dummy variable which was coded .5 for the person with OA and -.5 for the support provider; we examined its interaction with all other effects. Thus, the equations were as follows:

$$\text{Empathic Accuracy}_{ij} = \beta_{00} + \beta_{0j} + \beta_{10}*\text{Role}_{ij} + \beta_{20}*\text{Independent Variable } 1_{ij} + \beta_{30}* \text{Independent Variable } 1_{ij}*\text{Role}_{ij} + \beta_{40}* \text{Independent Variable } 2_{ij} + \beta_{50}* \text{Independent Variable } 2*\text{Role}_{ij} + \ldots$$

$\text{Empathic Accuracy}_{ij}$ is empathic accuracy for member i of couple j, so that each partner's empathic accuracy is considered separately. β_{00} is the fixed, overall intercept value and β_{0j} is the intercept random effect for couple j. The other β values are slopes for the various effects. Role_{ij} is the role for member i of couple j (person with osteoarthritis or support provider). Independent variable values are each provided for member i of couple j.

Results tables list results for main effects, and the result for each effect's interaction with the role variable is listed in a separate column labelled "Person with OA vs. Support Provider." If interactions with role were significant, we performed the analysis again using a "Person with OA" (PWOA) dummy variable (coded 1 if member i of couple j was the main partner and 0 otherwise) and a "Support Provider" (SP) dummy variable (coded inversely). This results in the following equation:

Empathic Accuracy$_{ij}$ = β_{00}*PWOA$_{ij}$ + β_{0j} + β_{10}*SP$_{ij}$ + β_{20}*Independent Variable 1$_{ij}$*SP$_{ij}$ + β_{30}* Independent Variable 1$_{ij}$*SP$_{ij}$ + β_{40}* Independent Variable 2$_{ij}$ *PWOA$_{ij}$ + β_{50}* Independent Variable 2*SP$_{ij}$ + …

With this coding, slopes for interactions with the "Person with OA$_{ij}$" variable were the effect for the person with OA in each couple and slopes for interactions with the "SP$_{ij}$" variable were the effect for the support provider. Results for these analyses, if performed, are provided in-text.

Finally, we separately tested several possible covariates to see if any were associated with empathic accuracy, acting as a possible confounding variable. We then reran the original analyses with any covariates that were significantly associated with empathic accuracy. The results of analyses investigating the association between each potential covariate and empathic accuracy are included in the online supplement.

Power calculations were performed using the APIM power calculator developed by Ackerman, Ledermann, and Kenny [31]. Due to problems in recruitment, our final sample size was smaller than planned, and the study is only adequately powered (β = .8) to identify a d = .69 (partial r = .348) size effect under standard assumptions. We also ran a post-hoc power calculation to estimate power to detect an effect of partial r .24, the effect size of the smallest effects which were found in the study. Power was β = .635.

Results

Full data and code for the presented analyses can be found on the OSF website at [REDACTED FOR BLIND REVIEW].

Descriptive Statistics

Descriptive statistics for all study variables (excluding the Discussion Outcome variable) are presented in Table 1. Zero order correlations are presented in the supplemental material. Concerning Discussion Outcome, in 15 discussions (35.7%) couples reached a solution. In 10 discussions (23.8%) couples were on track to reach a solution. In 6 discussions (14.3%) couple discussed solutions, but it was unclear if they were moving towards an agreed upon solution. In 5 discussions (11.9%) couples discussed one or more solutions but did not reach a clearly formed solution by the end of their time. In 6 discussions (14.3%) participants went off topic, in that they did not discuss any solutions.

Hypothesis 1

To test whether empathic accuracy was associated with better discussion outcomes, we performed two mixed linear regression analyses in the manner described above. For these analyses, each of the five possibilities for couples' discussion outcomes (solution reached, on track, unclear, no solution, off topic) was coded as a dummy variable. Both models included four of the five dummy variables as independent variables, making the omitted outcome type the comparison group. The first model used "solution reached" and the second used "no solution" as the comparison group. Empathic accuracy was the dependent variable. Empathic accuracy for participants grouped by discussion outcome is displayed in Table 2, and analysis results are shown in Table 3.

In the model using "solution reached" as the comparison group, we found that participants in couples who reached no solution had significantly less empathic accuracy than participants in couples who reached a solution. The same was true for participants in couples who were on track to reach a solution but did not reach it. The empathic accuracy of participants in couples who went off topic and of those whose resolution was unclear (e.g.,

because they mentioned some options but did not seem to be moving toward endorsing or agreeing on any of them) did not differ significantly from those who reached a solution.

Findings from the model using "no solution" as the comparison group mirrored findings from the first model. Specifically, participants in couples who reached a solution had significantly more empathic accuracy than participants in couples who did not reach a solution. All other solution types did not differ significantly from "no solution".

There were no significant interactions with the participant role dummy variable, indicating that results of either model did not differ depending on whether analyses considered the empathic accuracy of the person with OA or of the support provider.

We also ran an exploratory analysis with outcome as a single variable, as detailed above. In line with the categorical findings, empathic accuracy was significantly associated with better outcomes (b = 8.64 (SE = 3.23), $t(39) = 2.673$, p = .011, Effect Size r = .305). Full results for this analysis are provided in the supplementary material.

Hypothesis 2

We conducted two mixed linear regression analyses to examine associations between positive and negative affect and empathic accuracy in the manner described above. Results are shown in Table 4.

Controlling for pre-discussion negative affect, greater participant empathic accuracy was significantly associated with less partner post-discussion negative affect[2]. Contrary to our hypothesis, greater participant empathic accuracy was also significantly associated with less partner post-discussion positive affect (controlling for pre-discussion positive affect). We

[2] EA was also significantly associated with *more* pre-discussion negative affect. However, this association appeared only when post-discussion negative affect was included in the analysis and thus seems to be a statistical artifact.

also found a significant interaction with the participant role dummy variable. The association between empathic accuracy and partners' positive affect differed between people with OA and support providers (*b(SE)* = -2.437(1.177), *t(28)* = -2.07, *p* = .048, Effect Size r = -.232). A follow-up analysis examining people with OA and support providers separately found that this effect held only for people with OA (*b(SE)* = -2.497(1.017), *t(28)* = -2.455, *p* = .021, Effect Size *r* = .27): When people with OA had greater empathic accuracy, their partners had less post-discussion positive affect, whereas support providers' empathic accuracy was not associated with the post-discussion positive affect of their partners. Full results for secondary analyses are provided in the supplementary material.

Exploratory

We used two mixed linear regression analyses to explore the association between empathic accuracy and the five communication and emotion regulation skills. Communication skills were not associated with empathic accuracy. For emotion regulation skills, only actor emotional clarity was significantly associated with higher empathic accuracy. Results did not differ depending on whether analyses considered the empathic accuracy of the person with OA versus the support provider. Thus, each participant's own empathic accuracy was associated with their own emotional clarity but not the emotional clarity of their partner; this finding did not depend on whether the participant was a person with OA or a support provider. Full results of both analyses are presented in the Table 5.

Covariates

To rule out possible confounding factors, we looked at the association between various demographic factors and empathic accuracy. Interactions with participant role (PWOA or support provider) were examined for each covariate, as well as actor and partner

effects for variables which differed between partners. Full results are included in the supplemental material.

Gender, relationship length, age, race, employment status, being disabled, body mass index (BMI), income, having a high school education, relationship satisfaction, pain reported by the person with OA (either at the moment or over the last week), study compensation (being paid $100 or $150) and self-reported health were not associated with empathic accuracy ($p > .1$ for all associations). Having a 4-year college education, one's partner being retired, and actor and partner performance issues (i.e., self-reported problems with the ability to perform normal day-to-day tasks due to disability) were associated with empathic accuracy either directly or through an interaction with the role variable.

We reran our analysis with the covariates included. Due to low power, each analysis included only one covariate. Some significant findings became significant only in one-tailed tests (i.e., $p < .1$). Beyond that, the difference in empathic accuracy between couples who reached a solution and those who were merely on track became non-significant when including actor or partner performance (while the difference between couples who reached a solution and those who did not, as well as the single variable analysis, remained significant in a one-tailed test), and the negative association between negative affect and empathic accuracy became non-significant when including 4-year college education or actor performance issues.

Discussion

We examined antecedents and outcomes of empathic accuracy in the context of a discussion between an insufficiently physically active person with OA and their romantic partner, where the goal of the discussion was to jointly find a strategy to overcome a barrier to physical activity identified by the person with OA. In accordance with our first hypothesis, when people with OA or the support provider had higher empathic accuracy, couples were

more likely to reach a solution for overcoming the barrier to physical activity, when compared to those who reached no solution and those who were on track to reach a solution but did not reach one. These latter two groups did not differ and two other groups—those who went off topic and those whose progress toward a resolution was unclear (e.g., because they mentioned some options but did not appear to be moving toward endorsing or agreeing on any of them)—did not differ from either the group that reached a solution or the group that did not reach a solution. This finding extends previous research on the association between empathic accuracy and better relational outcomes [e.g., 15] by providing some evidence that empathic accuracy may also help couples work together to manage a chronic health condition. Because we do not know whether these couples implemented their chosen strategy after they left the study, future research is needed to evaluate associations with subsequent behavior change. Furthermore, our study design does not enable us to determine whether high empathic accuracy led to better outcomes or was merely a byproduct of some other relational process. However, covariate analyses show that no single other factor was fully responsible for the empathic accuracy effects. This suggests that empathic accuracy either directly promoted couples' effective problem solving or that it is a marker of some nontrivial relational characteristic beyond simple demographics or health parameters such as BMI, pain, and self-reported health. In either case, future longitudinal research is needed to help clarify plausible causal pathways and mechanisms, in addition to the association of empathic accuracy and health behavior change.

Our investigation of the mechanisms underlying the association between empathic accuracy and changes in affect after the discussion was less conclusive. In accordance with our second hypothesis, empathic accuracy was associated with a reduction in negative affect from before to after the discussion; this finding might indicate that participants with high empathic accuracy were able to reduce their partner's negative affect, possibly explaining

why they were more likely to reach a discussion outcome (of course, see above for caveats on causal conclusions).

Importantly, the association became non-significant when controlling for college education or actor performance. However, this finding does not necessarily disconfirm our hypothesis. Although these variables were associated with empathic accuracy, our correlational study design cannot distinguish between causal explanations, some of which are consistent with our hypothesis whereas others are not. For instance, concerning college education, the first possible causal path would be that couples with a 4 year college education[3] were more empathically accurate which in turn helped them reduce negative affect. In other words, empathic accuracy would be a mediator of the association between education and negative affect. This causal path would be consistent with our hypothesis. The second possible causal path would be that something about college education helped couples reduce negative affect, while education is also, unrelatedly, associated with empathic accuracy. In that case, the association between empathic accuracy and negative affect would be spurious due to confounding by college education. This causal path would contradict our hypothesis. Similar causal paths exist for actor performance. Future studies could distinguish these cases by using larger samples and by experimentally manipulating empathic accuracy.

Contrary to our second hypothesis, greater empathic accuracy in people with OA was associated with reduced positive affect for their partners. One possible explanation could relate to findings showing that people in positive moods can have difficulties processing depressing information [32]. Thus, people with OA who have higher empathic accuracy might strategically engage in behaviors that reduce their partner's positive state in order to focus on their barrier, in order to facilitate discussion.

[3] In all participant couples either both or none of the partners completed a 4-year college, making education a couple-level variable in this sample

As opposed to the associations between empathic accuracy and *target* affect discussed above, no association was found between empathic accuracy and *perceiver* affect (i.e., the affect of the participant trying to infer their partner's mood). Although previous research demonstrated negative outcomes for perceivers with high empathic accuracy [16,17], that research focused on couples in interpersonal conflict, which might involve different processes than the cooperative discussions in the current study.

Our exploratory analyses found an association between emotional clarity and empathic accuracy; that is, participants who were more accurate in their assessment of their partner's thoughts and feelings were more likely to report typically feeling clear about and comfortable with their own feelings. Thus, the ability to understand one's own emotions and another's emotions may be related skills. In contrast with our hypothesis, empathic accuracy was not associated with any other communication or emotion regulation skills. Although caution should be taken in interpreting null findings in a low-powered study, these findings seem to indicate that empathic accuracy might be a relatively unique capability and not simply a derivative of most other relational skills.

Future Directions, Limitations, and Conclusion

The current study indicates that empathic accuracy can be an important factor in the ways couples deal with health-related issues, while providing preliminary evidence for the role of emotional clarity in achieving it. This can be a crucial practical issue when patients and their partners try to jointly overcome barriers to engaging in physical activity.

Our findings on discussion outcome and affect suggest that it may be beneficial to identify osteoarthritis patients and partners who have high empathic accuracy and encourage them to work with their partners on overcoming barriers to physical activity. This may provide them with critical assistance in managing a potentially debilitating chronic condition.

Further research could show whether this is generalizable to other lifestyle changes required by various medical conditions. For patients with low empathic accuracy, other methods may be more appropriate to help them sustain these changes. Alternatively, interventions could be applied to improve empathic accuracy (e.g., Imago therapy [33]).

Our findings on the association between empathic accuracy and emotional clarity, while exploratory, provide one of the first reported links between empathic accuracy and a specific emotional regulation skill. Intervening to increase emotional clarity (e.g., through mindfulness training [34]) might raise patients' empathic accuracy, which might in turn help them get better support from their romantic partners.

As mentioned above, this study was somewhat underpowered; its findings should be treated as provisional until they are replicated in future studies. It is also a correlational study and therefore cannot be used to draw strong conclusions about causality. However, findings indicate that additional research is warranted. Future studies can build upon these exploratory findings by focusing on the link between emotional clarity and empathic accuracy and manipulating either of these variables to establish causal links. Alternatively, longitudinal research can allow investigators to explore the plausibility of causal effects and could also extend the current study by investigating whether better discussion outcomes translate into subsequent health behavior change.

Despite these limitations, our findings are unique in their contribution to understanding the role of empathic accuracy in how couples work together to manage OA, a chronic health condition. The high prevalence and substantial public health impact of OA make it a worthwhile target for this research, which may inform efforts to help people with OA make lasting lifestyle changes to reduce impairment caused by their symptoms.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all individual participants included in the study.

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Table 1. Descriptive Statistics

	Possible Range	Person with Osteoarthritis M(SE)	Support Provider M(SE)	Difference t(df)	Difference p
Empathic Accuracy	0-100	18.58(19.68)	22.1(17.37)	-1.07(36)	.29
Positive Affect at Baseline	10-50	34.3(7.4)	32.95(8.51)	.7(40)	.49
Negative Affect at Baseline	10-50	12.52(3.95)	11.65(2.44)	1.1(40)	.28
Positive Affect at Follwup	10-50	36.37(8.05)	35.28(8.14)	.69(41)	.49
Negative Affect at Followup	10-50	11.9(3.27)	11.84(4.28)	.07(41)	.94
Problem Solving	0-19	6.33(4.83)	6.52(4.42)	-.27(41)	.79
Affective Communication	0-13	3.33(3.07)	2.88(2.52)	1.09(41)	.28
Attention to Feelings	1-6	4.41(.67)	4.45(.56)	-.34(41)	.73
Clarity of Feelings	1-6	4.73(.64)	4.69(.72)	.28(41)	.78
Mood Repair	1-6	4.74(.78)	4.67(.78)	.43(41)	.67

Table 2. Mean Empathic Accuracy by Discussion Outcome

	Person with Osteoarthritis M(SE)	Support Provider M(SE)	Difference t(df)	Difference p
Solution reached	28.8(22.53)	27.22(16.33)	.18(11)	.86
On track	10.72(12.3)	20.62(18.9)	-1.49(9)	.17
Solution unclear	22.36(28.14)	17.79(16.21)	.35(5)	.74
No solution	6.49(6.84)	17.4(13.6)	-1.25(4)	.28
Off topic	17.05(6.96)	20.83(23.27)	-.88(3)	.45

Possible range for empathic accuracy values is 0 to 100.

Table 3. Association between discussion outcome and empathic accuracy.

					PWOA vs Support Provider (i.e. interaction with role variable)		
	Mean(SE)	t(df)	p	Effect Size (r)	t(df)	p	Effect Size (r)
			"Solution Reached" as the comparison group				
Intercept	27.99(3.75)	7.47(36)	< .001***	.34	.23(32)	.82	.03
Solution Reached	--	--	--	--	--	--	--
On Track	-12.32(5.68)	-2.17(36)	.04*	-.26	-1.11(32)	.28	-.12
No Solution	-16.05(7.11)	-2.26(36)	.03*	-.27	-.96(32)	.34	-.1
Unclear	-7.92(6.67)	-1.19(36)	.24	-.14	.25(32)	.81	.03
Off Topic	-9.39(7.17)	-1.31(36)	.20	-.15	-.46(32)	.65	-.04
			"No Solution" as the comparison group				
Intercept	11.94(6.05)	1.98(36)	.06†	.14	-.99(32)	.33	-.11
No Solution	--	--	--	--	--	--	--
On Track	3.73(7.4)	.5(36)	.62	.06	.07(32)	.94	.01
Solution Reached	16.05(7.11)	2.26(36)	.03*	.27	.96(32)	.34	.1
Unclear	8.13(8.19)	.99(36)	.33	.12	1.04(32)	.31	.11
Off Topic	6.65(8.6)	.77(36)	.44	.1	.41(32)	.69	.05

† p < .1 * p < .05 ** p < .01 *** p < .001 PWOA – Person with Osteoarthritis

Table 4. Association between affect and empathic accuracy.

					PWOA vs Support Provider (i.e. interaction with role variable)		
	Mean(SE)	t(df)	p	Effect Size (r)	t(df)	p	Effect Size (r)
Negative affect							
Intercept	22.79(17.29)	1.32(40)	.19	.14	.09(28)	.93	NA[1]
Actor Baseline	-.93(.86)	-1.09(28)	.29	-.12	-1.13(28)	.27	-.13
Partner Baseline	2.28(1.11)	2.06(28)	.05*	.24	.61(28)	.55	.08
Actor Follow-up	-.05(.67)	-.07(28)	.94	NA[1]	.72(28)	.48	.09
Partner Follow-up	-1.45(.68)	-2.15(28)	.04*	-.25	-.5(28)	.62	-.06
Positive affect							
Intercept	45.98(13.09)	3.51(40)	< .01**	.36	.83(28)	.41	.09
Actor Baseline	.38(.53)	.72(28)	.48	.08	-.29(28)	.77	-.04
Partner Baseline	.82(.6)	1.36(28)	.18	.14	1.53(28)	.14	.17
Actor Follow-up	-.58(.5)	-1.16(28)	.25	-.12	.26(28)	.80	.03
Partner Follow-up	-1.28(.57)	-2.26(28)	.03*	-.24	-2.07(28)	.05*	-.23

[1]Model with variable explained less variance than model without variable * p < .05 ** p < .01 *** p < .001 PWOA – Person with Osteoarthritis

Table 5. Associations between emotion regulation and communication skills and empathic accuracy

					PWOA vs Support Provider (i.e. interaction with role variable)		
	Mean(SE)	t(df)	p	Effect Size (r)	t(df)	p	Effect Size (r)
Emotion Regulation Skills							
Intercept	-45.78(33.95)	-1.35(40)	.19	-.15	-.6(24)	.55	-.06
Actor Attention to feelings	2.95(3.66)	.81(24)	.43	.09	1.46(24)	.16	.16
Partner Attention to Feelings	3.96(3.75)	1.06(24)	.30	.11	-1.26(24)	.22	-.15
Actor Clarity of Feelings	7.45(3.42)	2.18(24)	.04*	.25	.74(24)	.47	.08
Partner Clarity of Feelings	-2.74(3.37)	-.81(24)	.43	-.09	.43(24)	.67	.05
Actor Mood Repair	1.08(3.16)	.34(24)	.74	.03	-1.27(24)	.22	-.15
Partner Mood Repair	1.75(3.18)	.55(24)	.59	.06	.93(24)	.36	.1
Communication Skills							
Intercept	25.92(4.49)	5.77(40)	< .001***	.26	.88(28)	.39	.09
Actor Problem Solving	-.6(.66)	-.92(28)	.37	-.1	-.71(28)	.48	-.08
Partner Problem Solving	-.44(.67)	-.65(28)	.52	-.08	-.63(28)	.53	-.08
Actor Affective Communication	.06(1.09)	.05(28)	.96	.01	.5(28)	.62	.06
Partner Affective Communication	.2(1.08)	.18(28)	.86	.02	-.27(28)	.79	-.03

* p < .05 ** p < .01 *** p < .001 PWOA – Person with Osteoarthritis

Figure 1. STROBE chart of recruitment