SUMMARY STATEMENT

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(Privileged Communication)

Release Date: **05/05/2025**
Revised Date:

Application Number: **1R15AR086481-01**

Principal Investigator

DILLON, CHRISTOPHER R

Applicant Organization: BRIGHAM YOUNG UNIVERSITY

Review Group: **ZRG1 MSOS-Q (80)**
Center for Scientific Review Special Emphasis Panel
AREA/REAP: Musculoskeletal, Skin and Oral Sciences

Meeting Date: **04/22/2025**
Council: **MAY 2025**
Requested Start: **07/01/2025**

Opportunity Number: **PAR-24-152**
PCC: **3 B**

Project Title: **Quantifying Achilles Tendon Stress in Female Ballet Dancers Using Shear Wave Tensiometry: Linking Dance Movements to Tendinopathy**

SRG Action: **Impact Score:39 Percentile:27 #**

Next Steps: **Visit https://grants.nih.gov/grants/next_steps.htm**

Human Subjects: **30-Human subjects involved - Certified, no SRG concerns**

Animal Subjects: **10-No live vertebrate animals involved for competing appl.**

Gender: **2A-Only women, scientifically acceptable**

Minority: **1A-Minorities and non-minorities, scientifically acceptable**

Age: **3A-No children included, scientifically acceptable**

Project Year	Direct Costs Requested	Estimated Total Cost
1	374,968	562,927
TOTAL	**374,968**	**562,927**

ADMINISTRATIVE BUDGET NOTE: The budget shown is the requested budget and has not been adjusted to reflect any recommendations made by reviewers. If an award is planned, the costs will be calculated by Institute grants management staff based on the recommendations outlined below in the COMMITTEE BUDGET RECOMMENDATIONS section.

1R15AR086481-01 Dillon, Christopher

RESUME AND SUMMARY OF DISCUSSION: This new R15 AREA application proposes to investigate Achilles tendon stress and related tendinopathy in female ballet dancers using shear wave tensiometry and questionnaires. The study team will first quantify tendon stresses associated with common ballet dance movements using shear wave tensiometry followed by the establishment of ballet-specific questionnaires related to Achilles tendinopathy, and finally they will identify the relationship between tendon stress and subsequent tendinopathy in this population. Reviewers felt the proposed work is moderately significant as the ability to improve shear wave tensiometry for the diagnosis of tendon injury and risk assessment has the potential to extend beyond ballet dancers; however, some reviewers were unclear on whether the newly developed questionnaire would overcome problems of the currently used gold standard questionnaire. The study team was viewed as strong with multi-disciplinary technical and dancer expertise and extensive student involvement. Additionally, reviewers felt the multidisciplinary opportunities for student development afforded through the proposed work are added strengths. The institutional environment at Brigham Young was viewed as very strong with a focus on both research and mentoring of undergraduate students. Additional strengths noted during discussion include the establishment of tensiometry best placement and repeatability in Aim 1 prior to further work, the involvement of both dancers and practitioners to develop a ballet-specific Achilles tendon pain survey, a clearly defined project timeline, consideration of potential pitfalls, and the proposed project would be the first to estimate tendon stress in ballet dancers using shear wave tensiometry. Weaknesses were generally viewed to be somewhat moderate including concerns related to the development of the tensiometer itself, rigor of prior research related to shear wave tensiometry is somewhat lacking, lack of power analysis for expected subject participation, lack of clarity regarding expected numbers of dancers that will develop tendinopathy as the provided rationale was lacking, and there was some question about how undergraduate students will be identified and recruited as this information is unclear. In summary, the review panel was enthusiastic about the application and the potential for the proposed work to provide knowledge regarding Achilles tendon injury and diagnosis in dancers as well as valuable research experience to students while enhancing the research environment of Brigham Young University, but noted weakness tampered reviewer enthusiasm. As such, the proposed application is expected to have a moderately high impact in the field.

DESCRIPTION (provided by applicant): Achilles tendinopathy is a painful injury that sidelines elite ballet dancers four times more frequently than other athletes and can end their dance careers. Ballet dancers train in extreme ranges of motion without periodization, placing intense and chronic stress on the Achilles tendon. Tendon stress is widely believed to be a major contributor to Achilles tendinopathy; however, the stresses during dance remain unknown because of difficulty in measuring Achilles tendon stress in situ. Additionally, it is difficult to evaluate the severity of Achilles tendinopathy in ballet dancers because the industry standard Victorian Institute of Sport Assessment-Achilles (VISA-A) survey is not sensitive to dancer pain. This project proposes to develop monitoring and survey tools that can quantitatively evaluate programs to prevent injury and facilitate rehabilitation in female ballet dancers. Our long-term objective is to establish a firm scientific foundation upon which clinicians, pedagogues, and athletes can build training and rehabilitation regimens that protect dancers from injury. Specific Aim 1: Quantify Achilles tendon stresses associated with dance movements using a new, wearable shear wave tensiometry system. We will adapt our current shear wave tensiometer to be portable and to accommodate female ballet dancers' large range of motion. We will identify which dance movements generate the greatest tendon stresses. We will validate shear wave tensiometry with dynamic Achilles tendon stiffness measurements from motion capture and musculoskeletal ultrasound (US). Specific Aim 2: Establish a ballet-specific questionnaire for Achilles tendinopathy. We will create a ballet-specific questionnaire to quantify the severity of Achilles tendinopathy in female dancers. Effectiveness will be

determined by correlating both the VISA-A and new questionnaires' results with visually apparent damage to the tendon as seen in US and magnetic resonance imaging. Specific Aim 3: Identify relationships between tendon stress and Achilles tendinopathy in ballet dancers. We will perform repeated tensiometry measurements in female ballet dancers over a full season to identify changes in Achilles stress and build a predictive model that correlates tensiometry data with Achilles tendinopathy pain established in survey questions and clinical diagnoses. Engaging a multidisciplinary team of experts and providing biomedical research experiences for over 15 undergraduate students, this project will inform clinicians and pedagogues about dance movements that may unintentionally accelerate or exacerbate Achilles injury and establish a clear link between tendon stress and Achilles tendinopathy. Further, by improving the quality and versatility of shear wave tensiometry, its impact will extend to injury diagnosis and assessment for other tendon injuries and to other athletes and the general population who experience Achilles tendinopathy.

PUBLIC HEALTH RELEVANCE: Achilles tendinopathy is a common and painful injury that sidelines elite ballet dancers and, in some cases, ends their dance careers. If clinicians and pedagogues better understood the Achilles tendon stress experienced during dance, they could more effectively develop or adapt training to prevent Achilles tendinopathy. This proposal seeks to address this need by developing shear wave tensiometry, a promising new technology to measure Achilles tendon stress during dance, and by creating a ballet- specific questionnaire that assesses the severity of Achilles tendinopathy in female dancers.

CRITIQUE 1

Significance: 5
Investigator(s): 2
Innovation: 4
Approach: 5
Environment: 2

Overall Impact: The proposal will examine the development of a tensiometer to examine the stress in the AT in ballet dancers and a questionnaire to be used to identify Achilles tendinopathy earlier. It is postulated that by understanding the ballet movements that produce the highest stress plans can be developed to slow or stop tendinopathy progression and keep dancers active. The significance of the proposal is diminished based on the lack of convincing support that the new questionnaire will overcome the problems with the current questionnaire. The investigators are suited to perform the proposed work and have all of the necessary expertise to accomplish the project. The approach has some modest concerns. The details regarding the development and testing of the new tensiometer should be strengthened, and the information pertaining to the questionnaire needs to be improved. The environment at the institutions is appropriate. The strengths slightly outweigh the weaknesses of the proposal.

1. Significance:

Strengths

- This proposal examines the development and assessment of Achilles tendinopathy in ballet dancers.

- The proposal seeks to develop a wearable device that can measure the stress in the tendon to identify ballet movements that put the greatest stress on the Achilles tendon to help mitigate tendinopathy progression and aid in the creation of rehabilitation programs.
- In addition, a new subjective assessment tool will be created to better identify ballet dancers with early signs of injury due to poor correlations with the current gold standard assessment and dancer injury.
- The premise used to justify the studies in Aim 1 is well presented.

Weaknesses

- The significance of the questionnaire development is not well presented. It is unclear how this new questionnaire will overcome the problems with the current gold standard. There is no discussion if this is a problem with other elite level athletes and how it has been cover come in those fields.

2. Investigator(s):

Strengths

- The investigators are suited to perform the proposed work and have all of the necessary expertise to accomplish the project.

Weaknesses

- None noted.

3. Innovation:

Strengths

- The conceptual innovation is modest. The technical innovation with the wearable tensiometer is appropriate.

Weaknesses

- The innovation with the questionnaire is not convincing.

4. Approach:

Strengths

- The approach is strengthened by the prior studies and investigators expertise. It is clear that the investigators are capable of performing the proposed work.

Weaknesses

- Aim 1: There are several modest concerns related to the development of the tensiometer. It is unclear how the vibration in the system will affect the measurement being made. This could be addressed with preliminary work. It would have been appropriate to already have the calibration for the device based nearer the musculotendinous junction since this could be significantly different than the previous calibration. How will the timing of the measurement affect the variability? During the start of the season there will be a learning curve in refamiliarization with the movements and induce confounding variations. Clarity is needed on the timing of the measurements. Improved rationale for the number of dancers tested and the number of measurements of each movement is needed.

- Aim 2: It is unclear that the new questionnaire will overcome the presented reasons for the poor diagnostic value of the current questionnaire. The groups used for pain and control in figure 9 are concerning since there is such a spectrum of VISA-A scores. It may be more appropriate to examine a correlation of the T2* value and VISA-A score. Why do you expect 30% tendinopathy? This needs to be justified.

5. Environment:

Strengths

- The environment at BYU is appropriate, and the investigators have access to all of the equipment and services needed to accomplish the proposed work.

Weaknesses

- None noted.

Protections for Human Subjects:

Acceptable Risks and/or Adequate Protections

- Appropriate

Inclusion Plans:

- Sex/Gender: Distribution justified scientifically
- Race/Ethnicity: Distribution justified scientifically
- For NIH-Defined Phase III trials, Plans for valid design and analysis: Not applicable
- Inclusion/Exclusion Based on Age: Distribution justified scientifically

Vertebrate Animals:

Not Applicable (No Vertebrate Animals)

Biohazards:

Not Applicable (No Biohazards)

Applications from Foreign Organizations:

Not Applicable (No Foreign Organizations)

Select Agents:

Not Applicable (No Select Agents)

Resource Sharing Plans:

Not Applicable (No Relevant Resources)

Authentication of Key Biological and/or Chemical Resources:

Not Applicable (No Relevant Resources)

Budget and Period of Support:

Budget Modifications Recommended (in amount/time)

Recommended budget modifications or possible overlap identified:

- The travel costs seem excessive and the material costs seem low.

CRITIQUE 2

Significance: 2
Investigator(s): 2
Innovation: 3
Approach: 6
Environment: 3

Overall Impact: This project addresses the problem of Achilles tendinopothy in ballet dancers from two different perspectives: (1) understanding how tendon stress in different ballet movements is related to the development of Achilles tendinopathy and (2) improving the self-reporting of pain via ballet-specific surveys. If successful, project outcomes could provide guidance for training regimens to prevent tendinopathy and earlier intervention to mitigate progression of tendinopathy. This will be the first use of shear wave tensiometry to measure tendon stress in ballet dancers, which will be made possible by several proposed design modifications. The multidisciplinary nature of the study team – spanning engineering and dance – and involvement of undergraduates are also viewed major strengths. Enthusiasm for the project, however, is dampened by a number of methodological issues such as a lack of clarity on how data will be analyzed, sample size estimates, and potential problems that are not addressed.

1. Significance:

Strengths

- Non-invasively measuring tendon stress in ballet dancers performing common ballet movements can provide needed information on the extent to which they place stress on the Achilles tendon, with the potential to guide training regimens to prevent tendinopathy.
- Developing a ballet-specific Achilles pain survey has the potential to be more sensitive than current surveys at capturing the early stages of Achilles tendinopathy, which may lead to earlier intervention.
- That ballet professionals are enthusiastic about this project (both in terms of the study team and previous participants) provides strong support for the significance of this type of study on the ballet field.
- The new design of the shear wave tensiometer to non-invasively estimate tendon stress has potential to be useful beyond ballet as well, due to its low cost, compact design, and wireless communication.

- The project will expose a wide array of students from different academic backgrounds to research. The multidisciplinary nature of student involvement will provide students with strong research experience in the type of team science required to address biomedical problems.

Weaknesses

- Significance could be strengthened by providing examples of how the information gained from this project would be used in practice.
- Rigor related to prior research on shear wave tensiometry is lacking. There is no discussion of whether this technique has been used to monitor unhealthy/injured tendon and potential confounding factors (e.g., swelling of surrounding tissue, swelling of the tendon itself, etc.). Addressing these issues possibly required before delving into the specific application of Achilles tendinopothy.

2. Investigator(s):

Strengths

- The PI has assembled a multidisciplinary team spanning engineering, exercise science, dance, and statistics. The team represents a nice convergence of both technical and dancer expertise.
- The team has a history of working together, including generating pilot data in support of the proposed project.
- The PI and Co-I's have been engaging undergraduates in this line of research already; over 20 undergraduate students across different disciplines were involved on the preliminary work for this proposal. Several of these undergraduate students have presented at conferences and have been involved in a published paper.

Weaknesses

- None noted.

3. Innovation:

Strengths

- The project will build upon a relatively novel/newer technique to estimate tendon stiffness – shear wave tensiometer – that they will modify for use in more dynamic and complex ballet movements.
- The project will be the first to estimate tendon stress in ballet dancers using shear wave tensiometry.

Weaknesses

- Innovation is primarily technically related. Given the large multidisciplinary team of undergraduate students in the project, there is a missed opportunity to leverage this to provide innovative engagement of students in research – such as ensuring those with technical background work closely with those with dance background.

4. Approach:

Strengths

- Undergraduate students will be involved in all aspects of the research project. The proposed project will also provide opportunity for graduate student to mentor and train undergraduates.

- The project is well-designed for one that will primarily be driven by undergraduates.
- The involvement of engineering disciplines (electrical and mechanical) often underrepresented in biomedical research, and multidisciplinary approach will strengthen research environment and experience at the applicant's institution.
- The first two aims are nicely designed to be pursued in parallel.
- Aim 1 will first establish best practices for tensiometer placement and repeatability before pursuing the actual exploration of tendon stress.
- The development of a ballet-specific Achilles tendon pain survey in Aim 2 will involve both dancers and practitioners, enhancing the likelihood of ballet specificity and also uptake and acceptance within the field once developed.
- The plan to utilize the entire time-history of tendon stress estimates in Aim 3 is viewed quite positively, as it may be not just stress magnitudes but also its rate of change that leads to injury.

Weaknesses

- There is the expectation that all undergraduates will be involved in the project for 1-2 years; there are no plans included to ensure rigor and consistency across the entire project period in the case that undergraduate students do not stay for the entire duration and are potentially replaced by a new student.
- Overall, the approach lacks detail on the specific analyses that will be performed. For example, it is not clear whether the analysis using the shear wave tensiometer measurements will be within-subject or across subject comparisons. This distinction is important given that the relationship between shear wave speed and tendon stiffness depends on individual-specific structure of the tendon and surrounding tissues.
- No rationale and/or power analysis was provided for the specific numbers of subjects in each sub-study.
- There is minor concern with participant recruitment, perhaps due to a lack of clarity on whether all sub-studies will require unique subjects or if subjects can participate in multiple sub-studies. The proposal details that there are approximately 40-50 ballet dancers between the two ballet companies from which they will recruit. Presumably these individuals are mostly the same from year to year, so to get 60 subjects across all aims would necessitate repeats of subjects.
- In Aim 1, it is not clear how the team will convert shear wave speed to tendon stress or even if they will convert it (i.e., just leave in terms of speed). The article that the team cites relates speed to stress using calibration during task in which tendon stress can be "accurately" measured. No discussion if that will be performed here too.
- The ballet-specific survey developed in Aim 2 could still suffer from underreporting of pain if the underreporting issue is due to not wanting to get sidelined or increased threshold for pain. Preliminary work presented by the team shows that VISA-A scores are not related to tendon injury measured via MRI. It is not clear why there would be a relationship between survey responses (either VISA-A or the new ballet-specific survey) and tendon stress measured using shear wave tensiometry in Aim 3.
- Aim 3 is dependent on the success of Aims 1 and 2. An alternative strategy is provided for what to do if Aim 2 (survey development) is unsuccessful, but no alternatives were presented in the case that Aim 1 (tensiometer development and validation) is unsuccessful. The goal for measurement success in Aim 1 is 90% reliability, but it is stated that the measurements may still be useful as long as reliability is >50%. It's not clear whether reliability on the lower end of this range would be good enough to achieve Aim 3 goals. No discussion of this point was included.

5. Environment:

Strengths

- The study team has all the necessary equipment and facilities for successful project completion.
- BYU is supportive of research, especially from undergraduates and many of them go on to pursue careers in biomedical sciences and medicine.

Weaknesses

- The project aims to support many undergraduate students, yet there is no discussion of how these students will be identified and recruited. The Facilities document briefly describes the “BE Together” program, but to what extent this program and/or any similar initiatives will be leveraged to recruit students to the project is unclear.

Protections for Human Subjects:

Acceptable Risks and/or Adequate Protections

- Low risk

Inclusion Plans:

- Sex/Gender: Distribution justified scientifically
- Race/Ethnicity: Distribution justified scientifically
- For NIH-Defined Phase III trials, Plans for valid design and analysis: Not applicable
- Inclusion/Exclusion Based on Age: Distribution justified scientifically
- Acceptable

Vertebrate Animals:

Not Applicable (No Vertebrate Animals)

Biohazards:

Not Applicable (No Biohazards)

Applications from Foreign Organizations:

Not Applicable (No Foreign Organizations)

Select Agents:

Not Applicable (No Select Agents)

Resource Sharing Plans:

Not Applicable (No Relevant Resources)

Authentication of Key Biological and/or Chemical Resources:

Not Applicable (No Relevant Resources)

Budget and Period of Support:

Recommend as Requested

CRITIQUE 3

Significance: 1
Investigator(s): 1
Innovation: 2
Approach: 1
Environment: 2

Overall Impact: This application from Dr. Dillon and 5 multidisciplinary co-investigators proposes to develop monitoring and survey tools that can quantitatively evaluate programs to prevent injury and facilitate rehabilitation in female ballet dancers, using three specific aims: 1) quantify Achilles tendon stresses associated with dance movements using wearable shear wave tensiometry system; 2) establish a ballet-specific questionnaire to quantify severity of Achilles tendinopathy; and 3) build a predictive model that correlates tensiometry data and tendinopathy symptomatology.

1. Significance:

Strengths

- This project will address a few significant questions: Female dancers as an understudied population of athletes who frequently sustain injuries (and perform with injuries), and the difficulty in quantifying Achilles tendon injuries, which in turn impacts treatment. It also aims to identify a predictive model, which would contribute to significantly push the field forward.
- The interdisciplinary nature of the proposal is a strength.

Weaknesses

- None noted.

2. Investigator(s):

Strengths

- This is a multidisciplinary team, described in Table A (p.9 and p.84) that incorporates expertise from dance, mechanical engineering, exercise sciences, MRI and biostatistics.
- PI Dillon is a junior faculty member of the Department of Mechanical Engineering, where he received start-up funding and reduced teaching load to establish a research program. Previously a postdoc at the U. of Utah and a computer scientist at Sandia National Lab. He is a former dancer. His work is highly collaborative (published) and includes students.
- Co-I Allen (professor, BYU) is one of the inventors of the tensiometer device referenced in the proposal.

- Co-I Allen (assistant research professor, Electrical and Computer Engineering, BYU) brings expertise in MRI techniques; he is also one of the primary inventors of an iron-based MRI-invisible coupling medium or transcranial focused ultrasound surgeries.
- Co-I Henderson (assistant professor, Exercise Sciences, BYU) brings skills to assess how mechanical properties impact not only performance but also long-term foot and ankle health.
- Co-I Bott (professor, Dance, BYU) brings expertise on cross-training, dance science, rehabilitation, and injury prevention for dancers.
- Co-I Dahl (Professor of Statistics, BYU) has ongoing collaboration with the PI (recent publication)
- Other collaborators include Critchfield, Director of the Dance, Medicine and Wellness facility, and Johnson, a physical therapist and professor of Exercise Sciences.

Weaknesses

- None of the biosketches describe student mentoring expertise.

3. Innovation:

Strengths

- The use of shear wave technology is novel. This project will adapt current shear wave tensiometer to be wearable, and validate the measurements obtained; it will also generate and validate a new questionnaire to quantify severity of Achilles tendinopathy.

Weaknesses

- None noted.

4. Approach:

Strengths

- Preliminary data was collected over 2 years with institutional seed funds.
- The project overall goal is to characterize Achilles tendon stress during dance and to relate tendon stress to Achilles tendinopathy in female ballet dancers.
- The timeline provided in p. 61 appears adequate.
- The specific aims are well justified, the techniques explained in sufficient detail, and particular attention to rigor and reproducibility. The methods employed are appropriate, validated and bound to obtain the data. Alternative explanations and potential pitfalls are considered.

Weaknesses

- Minor weakness is the lack of a methodological diagram to represent the project.
- The generation of the questionnaire is bound to have bumps on the road, but they are not acknowledged.

5. Environment:

Strengths

- Large institution with a strong focus on research (classified R2) and on mentoring of undergraduate students, to which this application would contribute. Institutional support for interdisciplinary work.
- This project aligns with institutional goals and offers a multidisciplinary opportunity for students to learn shear wave tensiometry, force plate and motion capture analysis, biomechanical modeling, survey development, magnetic resonance and ultrasound imaging, and biostatistics.
- The potential pool of study participants is quite large (about 4,000 students enrolled in dance per semester).
- Facilities and equipment are appropriate for the study.
- Involvement of students in the project is documented (p.60) and well described in the approach section. Funding for 2 graduate and 15 undergraduate students is included.

Weaknesses

- Unclear if study participants will be recruited from the large pool of dance students or from the small (25 students) group of Theatre Ballet dancers.

Protections for Human Subjects:

Acceptable Risks and/or Adequate Protections

- Appropriately described

Inclusion Plans:

- Sex/Gender: Distribution justified scientifically
- Race/Ethnicity: Distribution justified scientifically
- For NIH-Defined Phase III trials, Plans for valid design and analysis: Not applicable
- Inclusion/Exclusion Based on Age: Distribution justified scientifically

Vertebrate Animals:

Not Applicable (No Vertebrate Animals)

Biohazards:

Not Applicable (No Biohazards)

Applications from Foreign Organizations:

Not Applicable (No Foreign Organizations)

Select Agents:

Not Applicable (No Select Agents)

Resource Sharing Plans:

Not Applicable (No Relevant Resources)

Authentication of Key Biological and/or Chemical Resources:

Not Applicable (No Relevant Resources)

Budget and Period of Support:

Recommend as Requested

THE FOLLOWING SECTIONS WERE PREPARED BY THE SCIENTIFIC REVIEW OFFICER TO SUMMARIZE THE OUTCOME OF DISCUSSIONS OF THE REVIEW COMMITTEE, OR REVIEWERS' WRITTEN CRITIQUES, ON THE FOLLOWING ISSUES:

PROTECTION OF HUMAN SUBJECTS: ACCEPTABLE

INCLUSION OF WOMEN PLAN: ACCEPTABLE

INCLUSION OF MINORITIES PLAN: ACCEPTABLE

INCLUSION ACROSS THE LIFESPAN: ACCEPTABLE

COMMITTEE BUDGET RECOMMENDATIONS: The budget was recommended as requested.

Footnotes for 1R15AR086481-01; PI Name: Dillon, Christopher R

Ad hoc or special section application percentiled against "Total CSR" base.

NIH has modified its policy regarding the receipt of resubmissions (amended applications).See Guide Notice NOT-OD-18-197 at https://grants.nih.gov/grants/guide/notice-files/NOT-OD-18-197.html. The impact/priority score is calculated after discussion of an application by averaging the overall scores (1-9) given by all voting reviewers on the committee and multiplying by 10. The criterion scores are submitted prior to the meeting by the individual reviewers assigned to an application, and are not discussed specifically at the review meeting or calculated into the overall impact score. Some applications also receive a percentile ranking. For details on the review process, see http://grants.nih.gov/grants/peer_review_process.htm#scoring.

MEETING ROSTER

Center for Scientific Review Special Emphasis Panel
CENTER FOR SCIENTIFIC REVIEW
AREA/REAP: Musculoskeletal, Skin and Oral Sciences
ZRG1 MSOS-Q (80)
04/22/2025

Notice of NIH Policy to All Applicants: Meeting rosters are provided for information purposes only. Applicant investigators and institutional officials must not communicate directly with study section members about an application before or after the review. Failure to observe this policy will create a serious breach of integrity in the peer review process, and may lead to actions outlined in NOT-OD-22-044 at https://grants.nih.gov/grants/guide/notice-files/NOT-OD-22-044.html, including removal of the application from immediate review.

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