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Does exposure to university researchers improve undergraduate perceptions of research?:

A quasi cluster-randomized controlled trial

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ABSTRACT

This study explores the impact of talks by university researchers in different formats on students' perceptions of research. Undergraduate students ($N = 222$) were randomly assigned to watch research talks via video recording ($n = 78$), research talks presented live ($n = 67$), or a control group ($n = 77$). Students completed pre-intervention (Time 1) and post-intervention (Time 2) questionnaires on their perceptions of 1) university-specific research, 2) psychology-specific research, and 3) general research. Analysis of Variance (ANOVA) testing revealed that at Time 2, the video intervention group had significantly more positive perceptions about research compared to the control group. Several barriers to research involvement were noted, including competitiveness, lack of interest, lack of knowledge, and time constraints. Enhancing the undergraduate curriculum by integrating university researchers into the classroom is a potentially innovative way to introduce and promote research interests in students.

(150 words)

Keywords: *Educational Development, Research Integration, Pedagogy, Undergraduate Research, Higher Education*

Integrating Research in the Classroom

Historically in higher education, research and teaching have been recognized as separate entities. Traditional models of the relationship between research and teaching (i.e., pedagogy) indicates that research generates knowledge, and teaching transmits such knowledge to students (Brew, 2006). Brew (2006) argued for a new model that recognizes the more nuanced connections between research and teaching, as well as between academics and students. Fung (2017) has proposed a new framework for integrating research and pedagogy – the Connected Curriculum. This curriculum views connecting students with researchers and the research program at their institution as an integral component of student learning.

Integration of Research and Teaching: Impact on Undergraduate Students

The extent to which a connected curriculum can be implemented is dependent on students' academic institution and program of study (Fung, 2017). Linn, Palmer, Baranger, Gerard, and Stone (2015) compared the benefits of two forms of research experiences: in a faculty member's laboratory or course-based research experiences. Although hands-on experience in a laboratory may be viewed as ideal, knowledge about how to do this, time constraints, and knowing of opportunities all impact undergraduate exposure to the research process in general. According to Linn and colleagues (2015), course-based research exposure may be a more feasible way to demonstrate these processes to individuals who are uncertain of their research future, or experience barriers to accessing research opportunities.

Integrating research into the classroom can enhance students' academic experiences. Students have reported finding the incorporation of research intellectually stimulating, that it enhances their motivation and interest, adds to professor and institutional credibility, enhances positive perceptions of their professors, and enhances their enjoyment of being taught by

enthusiastic and well-known professors (Healy, Jordan, Pell, & Short, 2010; Jenkins et al., 1998; Neumann, 1994). More recently, research with undergraduate medicine students has shown that students' beliefs about the value of research for their learning is connected to the value they put in research for their future profession. Further, students' motivation for research was strongly related to beliefs about the value of research for current learning and future practice (Vereijken, van der Rijst, de Beaufort, van Driel, & Deckker, 2018). These findings demonstrate that students see the value in learning about research for their current and future learning.

Challenges of Incorporating Research in the Classroom

Students have also noted concerns with integration of research and teaching, including limited availability of professors, exclusion from the research process, or not seeing themselves as stakeholders in the research (Jenkins et al., 1998; Neumann, 1994). Moreover, given first-year students are typically still adjusting academically (Friedlander, Reid, Shupak, & Cribbie, 2007) it is possible that a focus on research skills on top of learning core academic skills might be perceived as overwhelming (Friedlander et al., 2007). Related, there is evidence to indicate that students do not believe research should take priority over their learning (Healy et al., 2010). It is important that course instructors make course content related to research interesting and relevant to students, while ensuring that research integration supports, and does not hinder the first-year university students' abilities to understand course material.

From a professor's perspective, academics have reported that some institutional policies and structures (e.g., large class sizes) do not allow for the coordination of teaching and research (Brew & Mantai, 2017). A related barrier is that some academics believe they lack the knowledge or understanding of how to implement research-based learning. A systemic shift that teaches faculty members these skills and promotes professional development in this domain is

warranted (Brew & Mantai, 2017), as they may require support on incorporating research-based learning into their teaching (Hu, van der Rijst, van Veen, & Verloop, 2014).

Aside from institutional factors, Brew and Mantai (2017) also found that some academics believe undergraduate students lack an understanding of research, enjoyment of research, and the skills required. This final barrier poses an important concern relevant to a Connected Curriculum framework and the integration of teaching and research. If research is not taught and incorporated into early undergraduate coursework, and students are unaware of research possibilities, they will continue to lack the set of skills expected of them in order to be more active contributors to the research being done at their institution.

Limitations of Existing Research

Based on a review of the current literature, there has been no prior assessment of the impact of different research presentation modalities (e.g., live content versus video content) on students' first-year experience. Examining different modalities of presenting research information to students, and whether this has an impact on their knowledge of research within their institution, is a fruitful area for exploration, and may suggest new, innovative ways to introduce students to the research process. Given the broader opportunities for learning, including online learning environments, this opens possibility for students to engage further with researchers (Fung, 2017).

Further, existing research has not consistently used methodologies (i.e., randomized controlled trials) that permit rigorous evaluation of the impact of research exposure on factors related to student success. There has been a call to incorporate more positivist research methodologies in the scholarship of teaching and learning. Such studies should include a control group comparable to intervention groups, and random assignment of groups to ensure that

potential confounds are equally distributed (Dreyhaupt et al., 2017). However, as it is not possible in education research to randomly assign individual students to specific course sections, these studies require a cluster randomized design, where entire groups can be randomized to a particular intervention or control group (Dreyhaupt et al., 2017).

The Current Study

In line with the first dimension of Fung's Connected Curriculum (2017; i.e., students connecting with researchers and with the institution's research), the current investigation examined integrating brief, university researcher lectures into an introductory-level course using a quasi-cluster randomized controlled trial design. The overall goal was to explore a new, innovative format for introducing undergraduate students to research by researchers from their own university. Specifically, the aim was to examine the effect of integrating researchers into the classroom (either in person or by video) on students' perceptions of research (institutional culture, specific to psychology research at the institution, research in general). Two introductory psychology course sections were randomly assigned to receive live research talks (in-vivo group) or video research talks (video group), and one section was assigned as the control group, receiving information about the same researchers via email. All groups were taught by the same instructor. Students completed a questionnaire assessing items pertaining to their perceptions of research generally, at their academic institution, and in the field of psychology at their institution. The questionnaire was administered at the beginning of the year (prior to intervention; Time 1) and after the intervention phase (Time 2).

The current study set out to answer the following research questions: 1) Do brief guest talks from university researchers increase students' perceptions of research?; 2) Are different modalities of brief guest talks (in-vivo versus video) equivalent in increasing student perceptions

of research?; and 3) As an exploratory qualitative research question, what do students identify to be the barriers to participating in university research labs during their undergraduate career?

Compared to the control group, it was hypothesized that both intervention groups would demonstrate an increase in their positive perceptions of research (Hypothesis 1). Further, we hypothesized that the intervention effect of being exposed to research talks would be greatest in students exposed to the live research presentations versus the video intervention (Hypothesis 2). No hypothesis was generated for the third research question as it was exploratory.

Method

Design

This study followed a quasi-cluster-randomized control trial design. Holding professor constant among the three groups was considered paramount in the research design. One class was assigned as the control group because it differed from the other groups in scheduling (twice per week for 1.5 hours). The other two groups were scheduled once per week (3 hours) and were randomly assigned to be the groups that received ‘live’ guest lectures (in-vivo group) versus those who were shown videos of the equivalent guest lecture (video group) using a coin toss. The primary outcome variables were students’ perceptions of university-specific research culture, psychology-specific research, and research in general.

Participants

Participants were students enrolled in one of three sections of Introduction to Psychology taught over the 2015-2016 academic year. Students were excluded if they reported that they attended another session of the professor, aside from the section in which they were enrolled. A total of 412 initially participated in October 2015, and 190 participants were lost between Time 1 (pre-intervention) and Time 2 (post-intervention). Figure 1 shows the Consolidated Standards of

Reporting Trials (CONSORT) participant flow diagram, which delineates participant loss over time.

Students completed questionnaires through the institution's Undergraduate Research Participation Pool online platform (URRP). Of the 222 participants who completed the study, the mean age was 19.08 years ($SD = 2.85$; Range = 17 – 38), and the population was 72.5% female. There were no significant differences among groups in terms of participant age, sex, ethnicity, self-reported major, and parent education (see Table 1 for demographic data based on group).

Measures

Perceptions of Research. Research engagement tends to be closely connected to academic success. Items pertaining to research engagement were selected from a broader set of items that touch on different factors related to student success (Lizzio, 2006). To address research perceptions, questions specifically pertaining to students sense of capability in participating in research, sense of purpose towards participating in research, sense of connectedness to the research processes, sense of resourcefulness in knowing how to approach the research process, as well as their sense of their institution's academic culture surrounding research participation, were selected (see Table 2). The broader questionnaire was piloted with 20 undergraduate students. Following questionnaire completion and a discussion about items with the undergraduate students, the final questionnaire had four questions pertained to the university's research culture, five questions pertained to psychology-specific perceptions of research, and six questions pertained to perceptions of research more generally.

Cronbach's alphas were calculated for each of the items grouped into these three composites. All composites demonstrated acceptable alpha ranges at both Time 1 and Time 2 – University Research: α 's = .79 - .78, Psychology Research: α 's = .73 - .78, and General

Research: α 's = .77 - .81. All questionnaire items pertaining to students' perceptions of research were scored on a Likert-Type scale from 0 (Not at all) to 10 (Extremely). To create an overall composite, scores on each item were summed. Total possible composite scores for University-Specific Research ranged from 0-40, for Psychology-Specific Research ranged from 0-50, and for General Research from 0-60. Higher scores represent more positive perceptions of research in these three domains.

Speaker coaching and creation of the talks. Guest speakers ($n = 3$ females, $n = 3$ males) were tenured, federally-funded researchers. They were coached to focus on ideas that are worth sharing, crafting slides that use minimal text and sharp visuals, and using a personal narrative format (Donovan, 2014). Speakers were given a manual on powerful speaking, had an orientation phone call with the senior investigator to help outline their talk, and had up to two individual meetings with the senior investigator and a local university TEDx organizer), where researchers presented their talks and received feedback (three speakers requested two meetings). Following feedback, speakers were given the opportunity to re-present their talk. Each of the six speakers were then videotaped in a professional University-based studio to create 9-minute videos regarding an idea from their research. Videos were shown to the video group and the same six speakers gave the same 9-minute talk during the term to the in-vivo group. A sample video can be obtained by submitting a request to ouchlab@yorku.ca and citing this paper.

The live presentation was video-recorded for equivalency to the studio-recorded version. Two research assistants took detailed notes from the video of both versions (e.g., number of seconds per slide, length of lecture, topic of presentation, and the amount of time spent on each topic). Each RA coded the versions independently, and their codes were compared for reliability. None of the talks significantly differed between the live and video versions.

Procedure

The institution's Research Ethics Board approved all study procedures. Participants completed pre-intervention questionnaires before any of the speakers were introduced. Following this, a research assistant and the senior investigator introduced the study to each of the three groups at the beginning of the Fall Term (October 2015). Both the video and the in-vivo groups viewed an introductory orientation talk on exciting aspects of the university's research and a brief overview of each of the talks that were to be presented throughout the year by the senior investigator. The video group was shown the professionally recorded research talks by the six researchers. The in-vivo group viewed presentations by these six professors in-person throughout the courses' duration. The control group did not view any talks, and instead received six emails throughout the year describing the same university researchers and provided a link to their website. Each group received their intervention in the same week. Lectures were scheduled such that three presentations occurred during the fall term and three in the winter term. Post-intervention questionnaires were completed in March 2016. These questionnaires were then analyzed both quantitatively and qualitatively.

Analysis Plan

Time 1 and Time 2 questionnaire items were missing between 2.7% and 15% of data; all data were deemed to be missing at random (Little's MCAR test: $\chi^2 (df = 5647) = 5708.12, p = .28$) so missing data were replaced using expectation maximization (EM) estimation. For quantitative analyses, an equivalency analysis approach was taken to ensure that the three study groups, in-vivo research talk group, video research talk group, and control group were not significantly different prior to their assigned intervention. Univariate Between-Group ANOVAs were run for all three outcome variables (University Research, Psychology Research, and

General Research) at Time 1 and at Time 2, resulting in six ANOVAs in total. ANOVAs and Chi squares comparing participants with full data and those who left after Time 1 were conducted on age, sex, and the three dependent variables at Time 1 to ensure attrition did not impact results.

The senior investigator (RPR) and a research assistant (RS) also conducted a basic qualitative descriptive analysis (Sandelowski, 2000) of all the written, open-ended answers to the question, “What are barriers to participating in research?” A codebook of nine descriptive themes was agreed upon. Two research assistants then read all the responses and classified each answer into one of the nine themes. All of the written responses were double-coded and classified independently. Reliability (percentage agreement) between the research assistants’ classifications among the nine categories was high (87%).

Results

Quantitative Results

First, no significant differences were found between the age, sex or Time 1 questionnaire results between participants who went on to complete Time 2 questionnaires, and those who dropped out prior to the Time 2 questionnaire administration. Second, equivalency analyses assessing university-specific, psychology-specific, and general research perceptions at pre-intervention were non-significant (p 's > .05), assuring groups were not significantly different prior to our intervention. Finally, for the primary analysis there was a significant effect of group on university-specific research perceptions ($F(2, 219) = 5.27, p = .006$), psychology-specific research perceptions ($F(2, 219) = 3.33, p = .038$), and general research perceptions ($F(2, 219) = 5.96, p = .003$). Regarding university-specific and general research perceptions, post-hoc analyses revealed a significant difference between the control group and the video intervention group, with the video intervention group reporting significantly stronger perceptions of research.

Regarding psychology-specific research perceptions, there was a trend toward significance in this same direction (see Table 3 for descriptive statistics). The effect sizes were: university-specific ($d=0.53$), psychology-specific ($d=0.32$), and general research perceptions ($d=0.58$)

Qualitative Results

A total of 343 responses were provided as barriers to getting involved in research. Nine barriers were identified (see Table 4). The four most common barriers are highlighted here. The most frequent barrier reported by undergraduate students ($n = 92$) was that research was too competitive. For example, one participant reported “competition between students” as a barrier (ID 1067), and another stated that “more older students [are] applying, and them getting preference over a first-year like me” (ID 3092) as a barrier. The second most commonly reported barrier was a lack of interest ($n = 65$), with several students simply responding with “not interested”. The third most commonly reported research barrier was a lack of knowledge of how to get involved in research at the university ($n = 57$). For example, one student explained that he or she had “not been exposed to the research opportunities so I do not know who to network with” (ID 3076). The fourth most commonly reported barrier was having no time to participate ($n = 52$). For example, one student noted “being busy and schedules may not match” (ID 3008).

Discussion

The goal of this study was to determine whether briefly showcasing university researchers during the academic year would enhance first-year students’ perceptions of research using a structured quasi-cluster randomized controlled trial. Two modes of guest speaker delivery (video and in-vivo groups) were compared to an electronically distributed summary of the researchers’ work (control group). A significant effect of exposure to researchers was identified in all categories of research perceptions. More specifically, compared to the control

group, students exposed to the research talks via video showed more positive perceptions of university-specific, psychology-specific, and general research. This finding partially confirms our hypothesis that exposure to research would enhance students' perceptions of research, however, we hypothesized that the effect would be greatest within the live research group. This was not the case. Students appeared to be more positively impacted by the video of the lecture.

The results of this study indicate that research integration through short, captivating videos of researchers improves first-year students' perceptions of research and lends support to the benefits of introducing research into the undergraduate curriculum. These videos may be an innovative way to introduce students to the exciting research being conducted in large universities. Although this study was conducted in a psychology course, the breadth of student majors in this sample suggests that these findings may transfer to practices in other areas of study. Future research may wish to explore the impact of these innovative research talks in other disciplines.

Several possible explanations are provided for the stronger effects from video exposure than live research. Following study completion, presenting researchers were apprised of the findings and invited to comment. Anecdotally, a number of researchers stated they felt less comfortable speaking in person than usual because of the experimental control requested (i.e., speakers were asked to deliver the same talk as the videotaped version). Researchers expressed that this constraint dampened their live lectures, as they knew their lecture was being evaluated for equivalency. Thus, the difference between the two intervention groups may be in part attributable to the experimental controls that were enforced. Future directions could include videotaping a live lecture (to use as the video comparator) to further pursue the intervention format. Alternatively, it is also possible that emerging adults (i.e., 18-24 years) are more

accustomed to hearing about novel educational content via video (e.g., YouTube © tutorials, Vimeo © clips, etc.) Thus, students in this age range may simply prefer a video instead of a live person when learning for pleasure. Students may have also enjoyed the break of watching a video inserted into a three-hour live lecture.

Findings regarding more positive perceptions of research in the video condition have important implications for future efforts to incorporate research into undergraduate curricula. When a professor is sharing their research live in the classroom, they are quite limited in what they can show (e.g., PowerPoint presentations, images of their lab). Although efforts to hold the lecture and video formats constant was taken, in reality, professors can show much more via video, including a tour of their lab space, research equipment, a mock procedure of a research study, and the day-to-day functioning of their lab. Further, with video format, there is the additional benefit of wider dissemination of exposure to researchers. It would be very difficult for busy professors to go from class to class in person. Therefore, using video format would ensure more students the opportunity to see inside a researcher's academic world, enhancing their sense of connectedness to ongoing research within their department. Of note, participants in this situation could only watch the video once, and it would be interesting to explore whether the ability of students to replay this video would strengthen effects.

An interesting trend was noticed in that regardless of group, positive research perceptions declined between Time 1 and Time 2. This may be explained by the research barriers reported. Competitiveness was the most commonly reported barrier to undergraduate student research involvement. It bears the consideration of how else students may be learning about research around their university. Although this study was interested in introducing research within the formal academic curriculum, what types of messages, values, and beliefs are students exposed to

in the social environment of their institution that has instilled this sense of competitiveness?

Exploring the role of the social environment on this sense of competitiveness would be an important future direction for research.

Another commonly reported research barrier was a lack of knowledge about how to get involved in research, which is easily preventable. In order to promote undergraduate research participation, it would behoove departments to offer specific didactics on how to become involved in research. In addition, given that many students reported limited time as a barrier, perhaps students early in their degree are still getting used to a post-secondary academic setting, and are too overwhelmed to consider research involvement. Given the importance of research experience to acceptance in graduate programs in many disciplines, first-year course instructors could help support students down the line by placing research involvement on their radars at the beginning of degree programs.

Limitations

Despite the interesting findings of this investigation, limitations are noted. First, authors were unable to hold constant the schedule format of the introductory psychology courses included. However, a conservative approach was taken where the optimal timing was assigned to the control group. Second, given there was loss of follow-up between Time 1 and Time 2, there may be an unknown factor associated with continuing in this study that limits generalizability of these findings. A final limitation is that we do not have knowledge of which students have gone on to become involved in research activities, which would be an important future direction for this research.

Conclusion

In conclusion, integrating research into the classroom through short nine-minute research lectures, specifically via video, may be an innovative way to expose students to research that enhances students' perceptions of research. There are also preventable barriers to getting students engaged in research early in their undergraduate careers, specifically by acknowledging their lack of awareness of these opportunities and addressing their perceived lack of time for such endeavors. These exploratory findings provide evidence for a more connected curriculum that can be generalizable to several disciplines. We hope to actively work to improve the first-year experience for students of multiple disciplines with the ultimate goal of enhancing students' positive perceptions of research, getting more students involved in hands-on research experiences, and in turn, promoting and supporting their educational development.

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CONSORT Flow Diagram

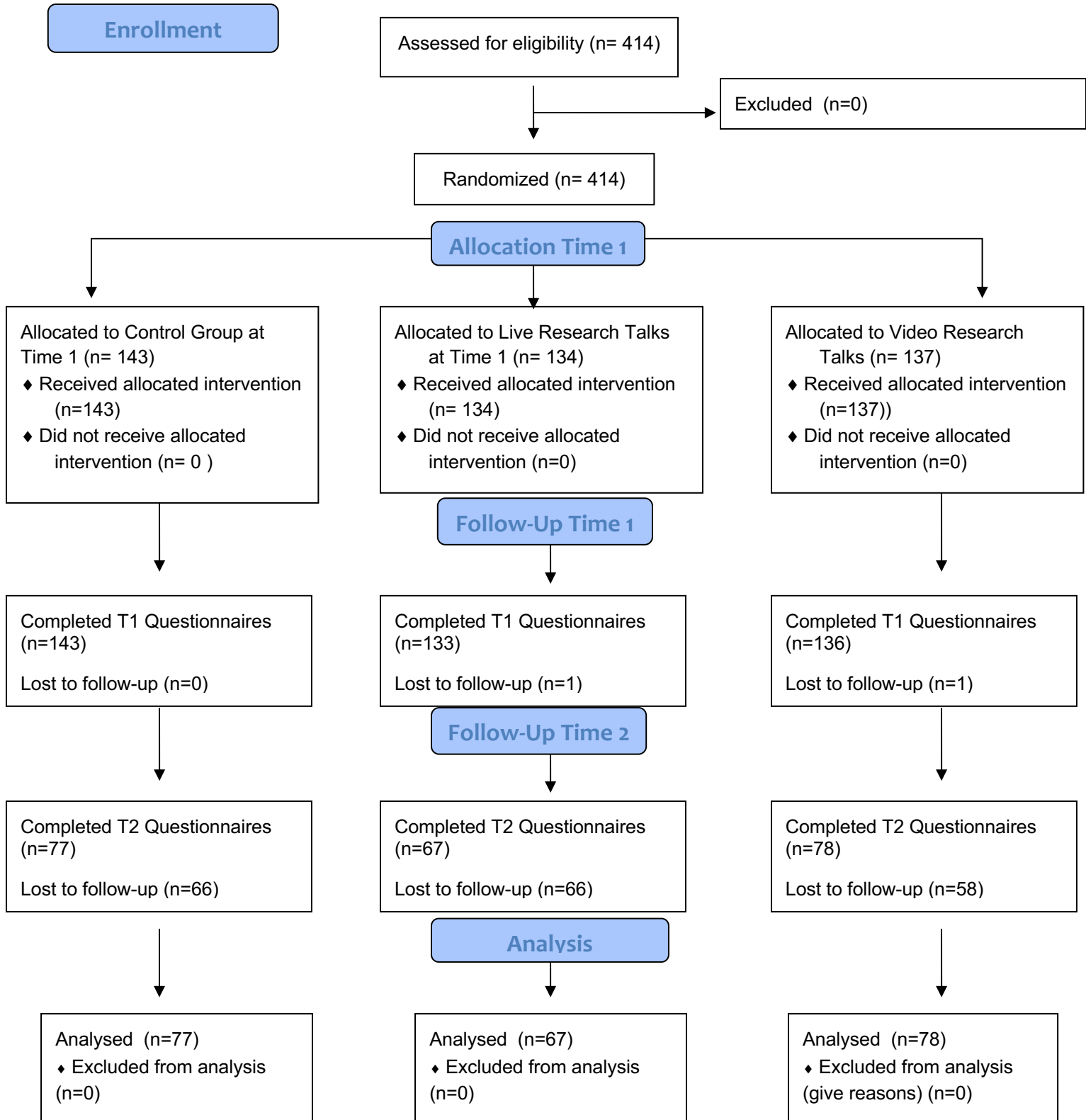


Table 1. Participant Demographics ($n = 222$) by Group

	Video Group ($n=78$)	In-Vivo Group ($n=67$)	Control Group ($n=77$)	<i>P</i> value
Mean Age (<i>SD</i>)	18.5 (1.75)	19.64 (4.05)	19.17 (2.38)	.051
Sex (% Male)	25.64	20.90	35.06	.149
Ethnicity (%)	Caucasian: 21.8 Asian: 59 Other: 19.2	Caucasian: 28.4 Asian: 55.2 Other: 16.4	Caucasian: 36.4 Asian: 41.6 Other: 22.1	.061
Year of Study (%)	Year 1: 100 Year 2: 0 Year 3: 0 Other: 0	Year 1: 97.01 Year 2: 1.49 Year 3: 0 Other: 1.49	Year 1: 96.10 Year 2: 2.60 Year 3: 1.30 Other: 0	.400
Parent Education (%)	University degree or higher: 64.1 Some university: 3.9 College: 12.8 High school: 14.1 Some High School: 5.1	Bachelor's degree or higher: 61.2 Some university: 3 College: 13.4 High school: 20.9 Some High School: 1.5	Bachelor's degree or higher: 61 Some university: 1.3 College: 9.1 High school: 19.5 Some High School: 9.1	.665

Note: All statistics represent data provided at Time 1 as more data was available.

Table 2. List of Questionnaire Items separated by Research Composite

University- Research Culture

1. How much importance do you feel York places on research excellence in Psychology? (0-10)
2. How much interest do you have in learning about research done by York researchers? (0-10)
3. What is the likelihood that you will volunteer in a non-Psychology research lab or with a professor at York before you graduate? (0-10)
4. How capable do you feel about your ability to getting a volunteer research position at York? (0-10)

Psychology-Specific Research at the University

1. Compared to other universities in Canada, how strong do you feel York's Psychology reputation is? (0-10)
2. How familiar are you with researchers or research labs at York psychology? (0-10)
3. How involved do you feel with Psychology researchers at York? (0-10)
4. What is the likelihood that you will volunteer in a Psychology research lab or with a professor at York before you graduate? (0-10)
5. How committed are you to getting a major or minor in Psychology? (0-10)

General Questions about Research

1. How knowledgeable are you about how to get involved in research? (0-10)
 2. How much interest do you have in learning about cool research generally? (0-10)
 3. How important do you think research participation is to your current degree? (0-10)
 4. How valuable do you find: gaining hands-on experience in research? (0-10)
 5. How valuable do you find: Clarifying whether I wanted to pursue a science research career? (0-10)
 6. How valuable do you find: Working more closely with a particular faculty member? (0-10)
-

Table 3: Descriptive Statistics

	Video Group (n=78)		In-Vivo Group (n=67)		Control Group (n=77)	
	<i>M (SD)</i>		<i>M (SD)</i>		<i>M (SD)</i>	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
University Specific Research	25.16 (7.23)	23.37 (7.09)	23.85 (8.65)	21.52 (8.35)	22.75 (7.22)	19.21 (8.52)
Psychology-Specific Research	24.33 (9.80)	23.89 (9.12)	22.42 (9.32)	19.99 (9.82)	23.35 (9.27)	20.69 (10.65)
General Research	39.64 (9.76)	38.57 (9.92)	38.29 (11.92)	36.16 (12.80)	36.64 (10.47)	32.31 (11.43)

Note. Total composite score ranged from 0 to 40 (University-specific research), 0 to 50 (Psychology-specific research) and 0 to 60 (General research), with higher scores indicating more positive research perceptions.

Table 4: Number of responses grouped into each of the nine themes ($n=343$ total responses)

Theme	Number of Responses
Not Having Strong Grades	18
Too Competitive	92
Too Busy/No Time	52
Specific Personal Responsibilities	41
No Interest	65
Don't Know How/Don't Know Where	57
Researcher-Related Reasons	4
Personal Limitations (Uncontrollable)	11
Financial Related Reasons	3