

MEDICAL AND DENTAL EDUCATION

Emotional Response of Undergraduates to Cadaver Dissection

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The most effective way to learn human anatomy is through cadaver dissection. Historically, cadaver dissection has been the provenance of professional schools. Increasingly, cadaver-based courses in human anatomy are shifting to the undergraduate level, which creates both problems and opportunities because of differences between undergraduate and graduate student populations. Anxiety associated with dissecting cadavers can create a barrier to learning, and ultimately, entry into the health and medical sciences for some demographic subpopulations of undergraduates. We surveyed 76 students in 2007 and 51 students in 2009 at four times in the semester to investigate the timing and sociodemographic predictors of anxiety over cadaver dissection. We followed this with a second survey of 44 students in 2014 to test the effect of humanization of cadaver donors (providing information about donor occupation and cause of death) to reduce student anxiety. Students experienced anxiety upon first exposure to cadaver dissection. Female students experienced greater anxiety than male students upon first exposure to cadavers but this effect was short-lived. Self-identified non-white, non-Christian students experienced sustained anxiety throughout the semester, likely because cadaver stress compounded social and financial stressors unique to international students. Humanization was effective in reducing anxiety in non-white, non-Christian students but had the unexpected effect of increasing anxiety in female students. We recommend that humanizing information be offered to students who seek it out, but not forced upon students for whom the information would only add to their stress. *Clin. Anat.* 31:224–230, 2018. © 2017 Wiley Periodicals, Inc.

Key words: cadaver dissection; emotional response; undergraduates

INTRODUCTION

The healthcare industry will likely see >10 million professional positions by 2016 (Barfield et al., 2011). Consequently, the human health sciences are the most popular and heavily enrolled STEM curricula in undergraduate education. Cadaver dissection has long been recognized as the best way to teach and learn human anatomy (Aziz et al., 2002; Korf et al., 2008). Cadaver dissection provides a tactile “learning-by-doing” experience that confers a deeper and longer-lasting knowledge of human tissues, introduces students to variability in human morphology, and establishes a powerful connection between the student and cadaver donor that is the precursor to the

relationship health care providers have with their patients (Arráez-Aybar et al., 2008).

Historically, cadaver-based training has been available only at post-graduate professional schools.

Additional Supporting Information may be found online in the supporting information tab for this article.

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TABLE 1. Distribution of Sex and Self-identified Ethnicity in the Student Population Surveyed

| | 2007 + 2009 | | 2014 | |
|-----------|-------------|-------|---------|-------|
| | Females | Males | Females | Males |
| White | 218 | 180 | 88 | 36 |
| Non-white | 65 | 45 | 36 | 16 |

Recent trends in medical training have led some medical schools to reduce or curtail their courses in gross anatomy to allow time for new curricula relating to advances in cellular and molecular biology, and genetics (Arráez-Aybar et al., 2008; Korf et al., 2008). Currently, about 10% of undergraduate pre-med programs incorporate cadaver dissection (Simpson, 2014). Given projected growth in human health job opportunities and competition among educational institutions to enroll these students, the market demand for cadaver-based courses at the undergraduate level is likely to increase.

In spite of the benefits of cadaver-based training, cadaver dissection can induce mild to severe anxiety for some students, especially on their first exposure (Finkelstein and Mathers, 1990; Snelling et al., 2003; Arráez-Aybar et al., 2004, 2008; Hancock et al., 2004). These psychological effects have been observed on students in their first year of medical school after committing to a career in medicine. It is not known how these same effects manifest in undergraduates that are at an earlier and less committed point in their career trajectory.

Here, we report the incidence of anxiety about cadaver dissection in a population of sophomore and juniors at a regional comprehensive liberal arts college. After describing the presence of anxiety and sociodemographic correlates of anxiety, we conducted an experiment to test if humanizing the cadaver donors by providing their demographic information and medical history to students would help them overcome their anxiety.

MATERIALS AND METHODS

Sociodemographic Predictors of Anxiety Associated with Cadaver Dissection

Student anxiety about cadaver dissection was measured at four time periods during the semester: (1) the first day of lab immediately before and (2) after cadaver dissection, (3) 6 weeks and (4) 12 weeks into the semester. Sociodemographic data were collected each time. A copy of the survey questions is included in the supplemental data. We collected these data for two independent cohorts of students; one in the fall of 2007 ($n = 76$ students) and the other in the fall of 2009 ($n = 51$ students).

Effect of Humanization of Cadaver Donors

In the fall of 2014, two lab sections ($n = 28$ students) were given information about their cadavers including where the donor came from, background

TABLE 2. Total Variance Explained for Principle Components Analysis of Responses to Questions About Anxiety for 2004 + 2007 Data

| Component | Initial eigenvalues | | | Extraction SS loadings | | |
|-----------|---------------------|--------|--------|------------------------|--------|--------|
| | Total | % Var | Cum % | Total | % Var | Cum % |
| 1 | 3.345 | 37.162 | 37.162 | 3.345 | 37.162 | 37.162 |
| 2 | 1.484 | 16.486 | 53.648 | 1.484 | 16.486 | 53.648 |
| 3 | 1.176 | 13.065 | 66.713 | 1.176 | 13.065 | 66.713 |
| 4 | 0.728 | 8.093 | 74.806 | | | |
| 5 | 0.589 | 6.549 | 81.356 | | | |
| 6 | 0.564 | 6.262 | 87.617 | | | |
| 7 | 0.487 | 5.412 | 93.03 | | | |
| 8 | 0.379 | 4.206 | 97.236 | | | |
| 9 | 0.249 | 2.764 | 100 | | | |

TABLE 3. Contributions of Variation in the Response of Each to Each Principle Component for 2004 + 2007 data

| Survey question | PC1 | PC2 | PC3 |
|---|--------|--------|--------|
| Ethics of human dissection | 0.560 | -0.239 | 0.521 |
| Difficulty of course material | 0.694 | 0.399 | -0.147 |
| Unfamiliarity of dissection techniques | 0.738 | 0.225 | 0.079 |
| Appearing incompetent in front of peers | 0.696 | 0.277 | 0.119 |
| General anxiety about school | 0.547 | 0.502 | -0.405 |
| Anticipation of fear and anxiety | 0.620 | 0.063 | -0.018 |
| Anticipation of nausea and disgust | 0.495 | -0.251 | 0.626 |
| Anticipation of interest | -0.602 | 0.625 | 0.313 |
| Anticipation of feeling excited | -0.479 | 0.656 | 0.456 |

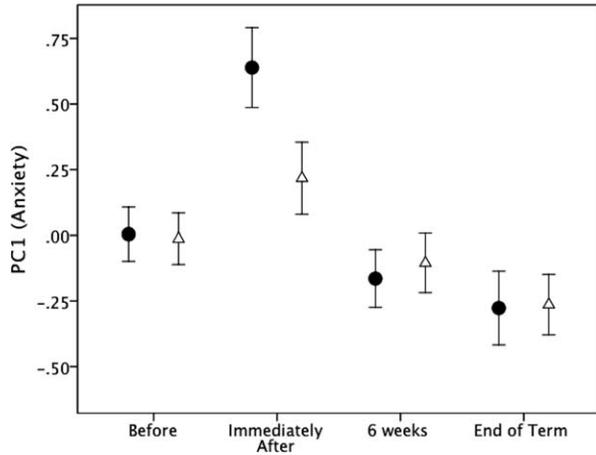


Fig. 1. Mean ± 1SE principle components score as an index of anxiety for males (open triangles) and females (solid circles) before and at intervals after first exposure to cadaver dissection.

medical history, why they donated their body and their principle occupation in life. This cohort was the Humanized treatment group. Two other lab sections ($n = 16$ students) were given no information about the cadavers. This cohort was the Non-Humanized treatment group. The general survey was given to all students in 2014 at the same four time intervals over the course of the semester.

RESULTS

Overall, the sex ratio of survey respondents was ~60% female and 40% male, and 76% white and 24% non-white (Table 1).

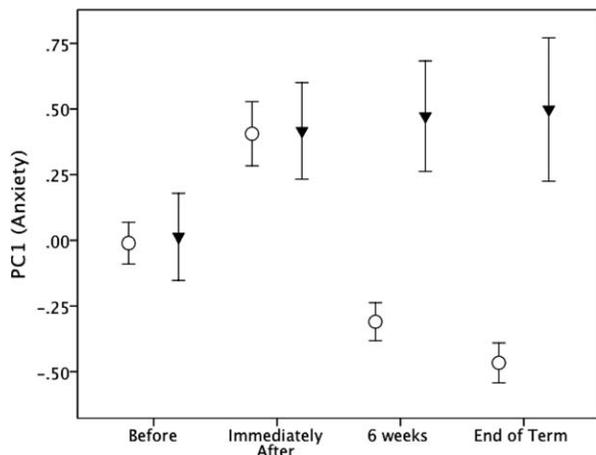


Fig. 2. Mean ± 1SE principle components score as an index of anxiety for students that self-identified as white European (open circles) or other (solid triangles) and at intervals before and after first exposure to cadaver dissection.

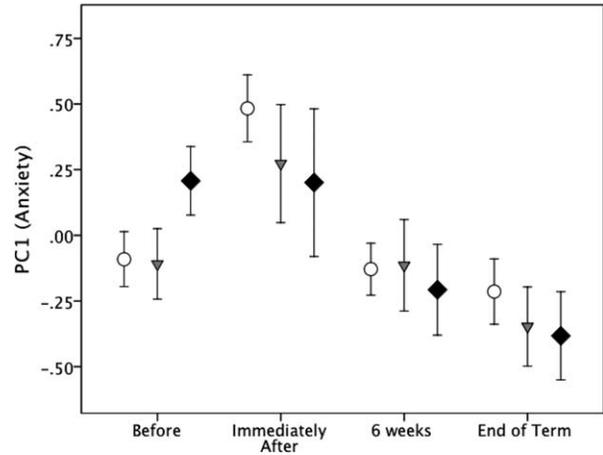


Fig. 3. Mean ± 1SE principle component scores for anxiety for (A) low (open circles), medium (shaded triangles) or high (solid diamonds) degree of self-reported degree of religiosity, and (B) effect of degree of religiosity on anxiety for students who self-identified as white (open circles) or non-White (solids triangles).

Sociodemographic Predictors of Anxiety Associated with Cadaver Dissection

The first principle component (PC1) captured 37.16% of the variation in the anxiety-related questions and serves as an index of cadaver anxiety. PC1 was correlated with responses to the question about anxiety over unfamiliarity with dissection techniques, difficulty of the material, appearing incompetent in front of their peers, general anxiety about school and ethics of human dissection (Tables 2 and 3).

Anxiety changed during the semester, peaking after the first lab with exposure to cadaver dissection ($F_{3,490} = 4.212, P = 0.006$). There were significant interactions with sex and ethnicity. Male and female

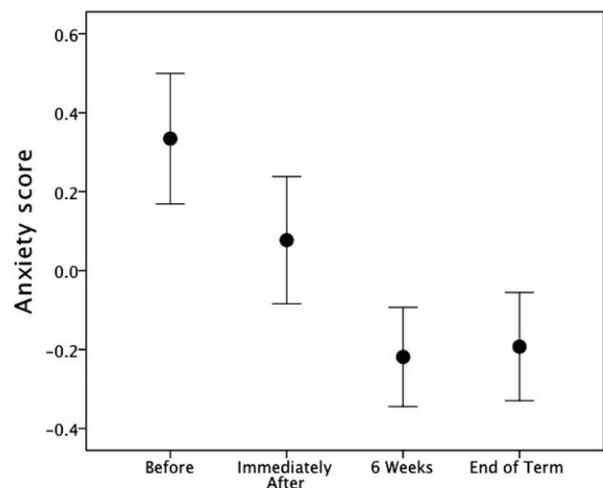


Fig. 4. Mean ± 1SE principle component scores for anxiety for 2014 when half of the students received humanizing information about the donors.

TABLE 4. Total Variance Explained for Principle Components Analysis of Responses to Questions About Anxiety for 2014 Data

| Component | Initial eigenvalues | | | Extraction SS loadings | | |
|-----------|---------------------|--------|--------|------------------------|--------|--------|
| | Total | % Var | Cum % | Total | % Var | Cum % |
| 1 | 2.695 | 29.95 | 29.95 | 2.695 | 29.95 | 29.95 |
| 2 | 1.673 | 18.587 | 48.537 | 1.673 | 18.587 | 48.537 |
| 3 | 1.058 | 11.755 | 60.292 | 1.058 | 11.755 | 60.292 |
| 4 | 0.894 | 9.937 | 70.229 | | | |
| 5 | 0.742 | 8.24 | 78.47 | | | |
| 6 | 0.612 | 6.799 | 85.269 | | | |
| 7 | 0.527 | 5.855 | 91.123 | | | |
| 8 | 0.464 | 5.155 | 96.278 | | | |
| 9 | 0.335 | 3.722 | 100 | | | |

students reported similar levels of anxiety (t tests, $P > 0.7$ for all) except for the period immediately after first exposure to cadaver dissection, in which females experienced higher levels of anxiety than males ($t = 2.059$, $df = 124$, $P = 0.042$; Fig. 1). Students who self-identified as white adjusted to cadaver dissection by 6 weeks whereas students who self-identified as non-white sustained high levels of stress through the semester (before: $t = 0.138$, $df = 129$, $P = 0.890$; immediately after: $t = 0.043$, $df = 124$, $P = 0.966$; at 6 weeks: $t = 4.460$, $df = 122$, $P < 0.001$; at end of term: $t = 4.737$, $df = 125$, $P < 0.001$; Fig. 2). Because students in our population are generally either white and Christian, or non-white, non-Christian international students, anxiety for students who identified as Christian and Non-Christian, showed almost the identical effect as for ethnicity (data not shown). Strength of religious conviction played a role in anxiety. Students who self-identified as being highly religious tended to show elevated anxiety from the beginning, although this was not demonstrable statistically (Fig. 3) because it was tied up in a significant interaction with religion (Christian versus Other * Religiosity $F_{2,490} = 15.415$, $P < 0.001$).

Effect of Humanization of Cadaver Donors

When we repeated the survey in 2014, with the added treatment of humanizing cadaver donors, there was again a significant change in cadaver anxiety across the four times when the survey was

administered (repeated measures ANOVA $F_{3,129} = 4.313$, $P = 0.006$) but the peak anxiety occurred during the anticipation phase before exposure to cadaver dissection, and quickly declined afterward (Fig. 4). The first principle component (PC1) captured 29.9% of the variation in responses to the survey on cadaver anxiety (Table 4), correlating most strongly with variation in responses to questions about difficulty of course material, appearing incompetent, general anxiety about school, and ethics of human dissection (Table 5). The pedagogical strategy of humanizing the cadaver donors had the effect of significantly reducing anxiety attributable to ethnicity (Table 6, Fig. 5 left panel). Students of non-white European ethnicity experienced elevated anxiety immediately after exposure to the cadaver when they had not received information about the donor occupation and medical history, but not if they did receive this information. Unexpectedly, the donor humanization process significantly elevated anxiety in female students relative to male students who had not received this information (Table 6, Fig. 5 right panel). This effect occurred immediately after initial exposure, and was sustained for the duration of the semester.

DISCUSSION

Most students experienced some level of anxiety during their first exposure to cadaver dissection. This is an understandable response because for the vast

TABLE 5. Contributions of Variation in the Response of Each to Each Principle Component for 2014 Data

| Survey question | PC1 | PC2 | PC3 |
|---|--------|--------|--------|
| Ethics of human dissection | 0.591 | 0.076 | 0.06 |
| Difficulty of course material | 0.662 | 0.248 | -0.356 |
| Unfamiliarity of dissection techniques | 0.603 | 0.187 | -0.06 |
| Appearing incompetent in front of peers | 0.614 | 0.511 | -0.169 |
| General anxiety about school | 0.614 | 0.076 | -0.226 |
| Anticipation of fear and anxiety | 0.554 | -0.089 | 0.566 |
| Anticipation of nausea and disgust | 0.495 | -0.172 | 0.649 |
| Anticipation of interest | -0.358 | 0.78 | 0.238 |
| Anticipation of feeling excited | -0.331 | 0.811 | 0.215 |

TABLE 6. Effect of Humanization on Anxiety Associated with Cadaver Dissection

| Time | Ethnicity | | Humanization | | Ethn * humanization | |
|---------------|--------------|--------------|--------------|-------|---------------------|--------------|
| | F | P | F | P | F | P |
| Before | 1.941 | 0.171 | 0.294 | 0.590 | 1.414 | 0.241 |
| Immed after | 0.358 | 0.553 | 0.197 | 0.660 | 4.183 | 0.047 |
| After 6 weeks | 0.136 | 0.714 | 1.263 | 0.268 | 0.050 | 0.824 |
| End of term | 0.101 | 0.752 | 0.017 | 0.897 | 0.480 | 0.492 |
| | Sex | | Humanization | | Sex * Humanization | |
| Time | F | P | F | P | F | P |
| Before | 0.328 | 0.570 | 0.310 | 0.581 | 1.869 | 0.179 |
| Immed after | 0.984 | 0.327 | 2.107 | 0.154 | 6.006 | 0.019 |
| After 6 weeks | 1.397 | 0.244 | 2.810 | 0.101 | 3.641 | 0.064 |
| End of term | 5.509 | 0.024 | 0.070 | 0.793 | 7.262 | 0.010 |

Two by two factorial ANOVA of self-reported white European heritage versus other ethnicity \times humanization of cadaver donors (see text), and 2×2 ANOVA for the effect of sex \times humanization. The degrees of freedom are $F_{1,40}$ for all. Significant terms are bolded ($P < 0.05$).

majority, this is their first direct confrontation with death and their own mortality (Finkelstein and Mathers, 1990). As found in many other studies of medical students, anxiety levels subsided quickly with regular exposure to cadaver dissection (Arráez-Aybar et al., 2004, 2008; Hancock et al., 2004).

Female students experienced more anxiety than male students, which concurs with previous studies (Abu-Hijel et al., 1997; Dickinson, 1997; Hancock et al., 2004). In our student population, the effect of sex on anxiety occurred for only the survey taken immediately after first exposure to cadaver dissection. Thereafter, sex had no effect on cadaver anxiety. Males generally approach cadaver dissection and in patient interactions as medical residents with greater emotional detachment than females do (Firth-Cozens and Field, 1991).

In our student population, "ethnicity" confounded race with religion, but it was clear that students who self-identified as white Christians recovered quickly from the initial stress associated with cadaver dissection while students from other demographic groups did not. This effect has been reported in some other studies (Snelling et al., 2003) in which the effect persisted for up to 12 weeks but not others (Hancock et al., 2004) where religion was reported to be a significant coping mechanism. The root cause of the effect of ethnicity in our population may be that most non-white non-Christians were international students who are burdened with a whole host of social and financial stressors that domestic students do not experience (Gonzales, 2000). Stress associated with cadaver dissection may compound these other stressors resulting in high and sustained anxiety scores on the survey (Evans and Fitzgibbon, 1992; Dinsmore et al., 1999). Successful student retention requires faculty to create a positive student learning environment where all students feel safe in the classroom setting (Tinto, 2006; Cahill and Ettarh, 2009). There are multiple reasons for the comparatively low percentage of American students earning undergraduate degrees in science, technology, engineering and math (STEM areas), and more still for the underrepresentation of minority students (Barlow

and Villarejo, 2004). The benefits of having a diverse class in health and medical programs are indisputable for the provision of health care to minorities, the under-served and the disadvantaged and low income populations (Cohen and Steinecke, 2006).

One strategy for ameliorating cadaver-related anxiety is to actively humanize the people who donated their bodies for anatomical instruction. A predissection orientation program (Bati et al., 2013) helps to emotionally prepare students and consequently reduce their anxiety upon first encounter with cadaver dissection. Similarly, anxiety can be reduced by providing detailed verbal information, visits to the dissecting room without cadavers, showing videos of cadaver dissection before direct exposure (Arráez-Aybar et al., 2004). We provided information about donor occupation and cause of death to students before their first exposure to cadavers and found that the elevated and sustained anxiety in non-white, non-Christian students disappeared. However, donor humanization exacerbated anxiety among female students (Robbins et al., 2008). Female students generally do not rely on detachment as a coping mechanism to avoid anxiety (Firth-Cozens and Field, 1991; Hancock et al., 2004). Therefore, humanization is not a general solution to cadaver anxiety, but may be a strategy that can be made available to students who take an interest in knowing. Offering humanization as a voluntary option available to students would allow students to self-select. Those who feel that knowing more about the donors would reduce their anxiety can seek out this information while students who need to maintain emotional detachment as a coping mechanism have the option to avoid confronting their anxiety until they are ready to do so.

Cadaver dissection is an indispensable component of anatomical teaching and learning that can and should be offered at the undergraduate level (Korf et al., 2008; Simpson, 2014). Special challenges associated with working with cadavers are manageable and do not present a barrier for students to enter careers in the pre-health sciences regardless of sex or ethnic background.

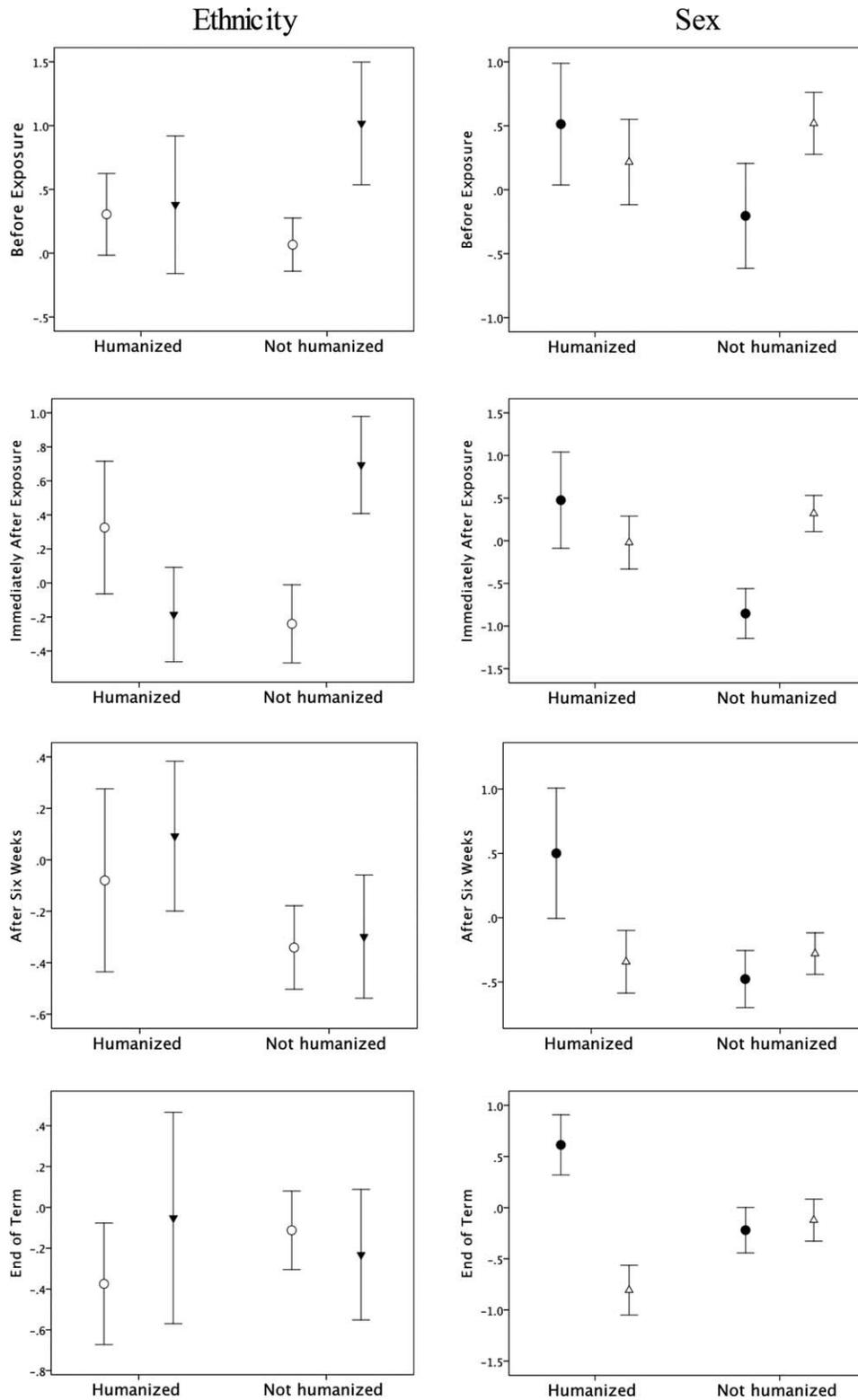


Fig. 5. Mean \pm 1SE principle component scores for anxiety for students at different times during the semester who (left panel) self-identified as white European descent (open circles) and students from other ethnic backgrounds (solid triangles) and (right panel) for males (open symbols) and females (solid symbols).

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