

Change of math anxiety in mathematics course for non-STEM university students in Japan

Takuo Oguro, Masahiko Okamoto, Mitsuru Kawazoe, and Kentaro Yoshitomi

Osaka Metropolitan University, Sakai, Japan, mokamoto@omu.ac.jp

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INTRODUCTION

Carey et al. (2016) proposed the reciprocal theory of math anxiety and math performance. According to this theory, math anxiety decreases math performance and poor performance increases math anxiety. In this one-year longitudinal study, we examined the relationships between gender, course selection, math performance, non-STEM students' interest in each topic, and math anxiety. Based on the reciprocal theory, we hypothesized that (1) non-STEM university students in Japan had higher math anxiety, and (2) their math anxiety would increase by studying university-level mathematics. Math anxiety was measured with the abbreviated math anxiety scale (AMAS; Hopko et al., 2003), which had two subscales: learning math anxiety (LMA) and math evaluation anxiety (MEA).

METHODS

Participants

The participants of this study were 129 first-year students (53 males, 68 females, and 8 non-respondents; mean age 18.52 ± 1.48 years) majoring in social and human environment at a Japanese university. They had taken the course "Basic Math I" in the first semester, and 75 of them continued to take the advanced course "Basic Math II" in the second semester. Both are activity-oriented courses in mathematical modelling, developed for non-STEM students (Kawazoe & Okamoto, 2017).

Measures

The survey was conducted three times: at the beginning (T1), at the end (T2) of the first semester, and at the end of the second semester (T3). The AMAS, translated into Japanese for this study, was used to measure math anxiety. The participants responded to items on a five-point Likert scale ranging from 1 (low anxiety) to 5 (high anxiety) (T1, T2, T3). They also responded to questionnaires about their math scores in entrance examinations (T1), attitudes toward learning (T1, T3), as well as their understanding and interest in each content (T2, T3). We also collected the scores of the online exercises conducted almost every week during the semesters. All data were collected on a learning management system.

RESULTS AND DISCUSSION

As hypothesized, math anxiety in Japanese students (LMA: $M = 12.9$, $SD = 4.9$, MEA: $M = 15.0$, $SD = 4.0$ at T1) was higher than Italian students (LMA: $M = 8.4$, $SD = 3.4$,

MEA: $M = 13.1$, $SD = 3.8$; Primi et al., 2014), especially in LMA.

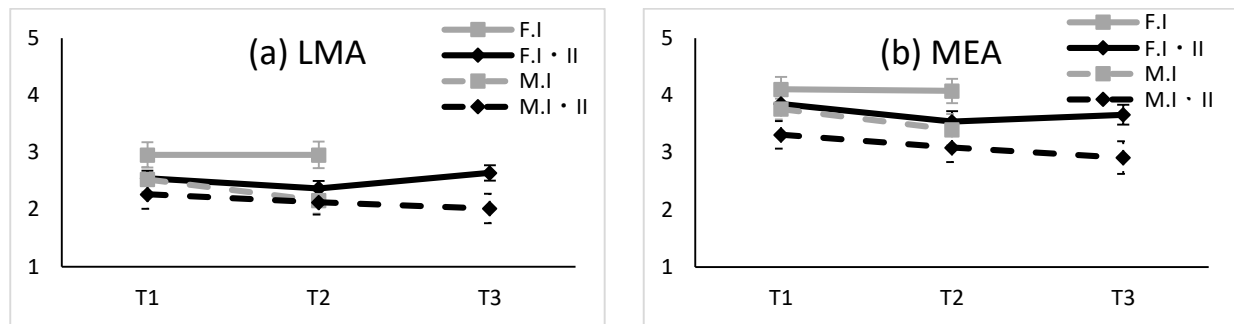


Figure 1: Math anxiety (points/item) as a function of time, gender, and course-taking.

Figure 1 presents the changes in math anxiety. A four-way ANOVA, 2 (gender: male/female) x 2 (course taking: Basic Math I/Basic Math I and II) x 2 (time: T1/T2) x 2 (math anxiety: LMA/MEA) indicated that the main effects of math anxiety ($F_{(1, 99)} = 254.08$, $p = 0.00$, partial $\eta^2 = 0.72$), gender ($F_{(1, 99)} = 7.77$, $p = 0.01$, partial $\eta^2 = 0.07$), course taking ($F_{(1, 99)} = 4.62$, $p = 0.03$, partial $\eta^2 = 0.04$), and time ($F_{(1, 99)} = 16.69$, $p = 0.00$, partial $\eta^2 = 0.14$) were significant. All interactions were not significant. A three-way ANOVA, which included anxiety, gender, and time (T1/T2/T3) for the participants who took Basic Math II, indicated significant main effects of anxiety and gender, and a marginally significant main effect of time ($F_{(1.56, 85.88)} = 2.86$, $p = 0.08$, partial $\eta^2 = 0.05$). A paired comparison for time revealed that math anxiety in T2 was lower than in T1 and other pairs were not significant. Our results revealed that the MEA was higher than the LMA, and in females, it was higher than in male university students, which was consistent with the findings of Hopko et al. (2003). Contrary to our hypothesis, math anxiety did not increase from T1 to T2. This result might be due to the features, activity-oriented and mathematical modeling, of the mathematics course.

REFERENCES

- Carey, E., Hill, F., Devine, A., & Szücs, D. (2016). The chicken or the egg? The direction of the relationship between mathematics anxiety and mathematics performance. *Frontiers in Psychology*, 6, Article 1987.
- Hopko, D. R., Mahadevan, R., Bare, R. L., & Hunt, M. K. (2003). The abbreviated math anxiety scale (AMAS): Construction, validity, and reliability. *Assessment*, 10(2), 178–182.
- Kawazoe, M., & Okamoto, M. (2017). A practical study of a design of university mathematics courses for the humanities and social sciences students. In T. Dooley, & G. Gueudet (Eds.), *Proceedings of the Tenth Congress of the European Society for Research in Mathematics Education (CERME10, February 1–5, 2017)* (pp. 2302–2303). Dublin, Ireland: DCU Institute of Education and ERME.
- Primi, C., Busdraghi, C., Tomasetto, C., Morsanyi, K., & Chiesi, F. (2014). Measuring math anxiety in Italian college and high school students: validity, reliability and gender invariance of the abbreviated math anxiety scale (AMAS). *Learning and Individual Differences*, 34, 51–56.