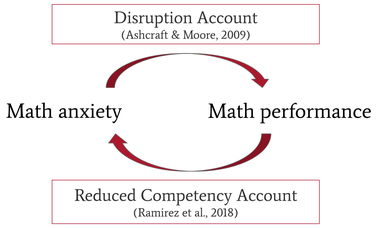
Person-Oriented Approach to Math Anxiety, Math Performance and Math Self-Efficacy Associations

Alena Egorova, Stacy T. Shaw, Ji-Eun Lee, Erin Ottmar
Worcester Polytechnic Institute

Background & Research Questions

- Research shows that anxiety in mathematics negatively correlates with mathematics performance:



- Some studies examined potential moderators in these relationships, showing that some highly math anxious students still perform well in mathematics (Ramirez et al., 2018).
- However, few studies examine how often students diverge from this linear relationships and which other variables can explain potential deviation from reduced competency account theory.

RQ1 How many groups will emerge if we cluster students based on their math anxiety and performance?
RQ2 How students from those clusters differ in math anxiety, performance, and self-efficacy?

Study 1

Participants. 1,029 students in 7th grade (typically 13-14-year-olds) from 11 US schools. 47% girls, 50% White, 27% Asian, 16% Hispanic/Latino, 7% Other.

Methodology. Online survey administered by teachers during math class across 2020-21 school year. A total of 76% of students attended class in person, others – remotely.

Math performance. Items adapted from Star et al. (2015): 4 – conceptual understanding in algebra, 3 – procedural knowledge, and 3 – math flexibility (see osf.io/bafdr). No feedback was given.

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Math self-efficacy. Academic Efficacy subscale of the Patterns of Adaptive Learning Scales (Midgley et al., 2000) adapted for math.

Study 2

Participants. 473 6th grade students from 14 US schools. 49% girls, 85% White, 5% Multi-racial, 3% Black, 3% Hispanic/Latino.

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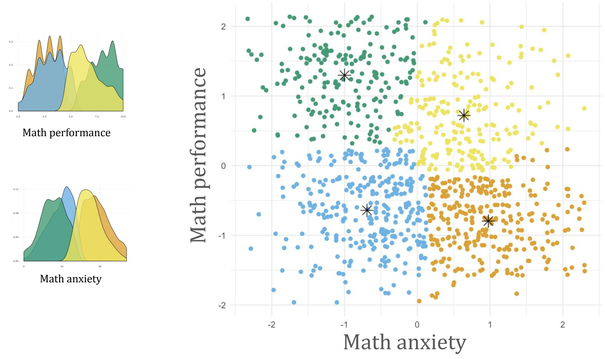
Math anxiety measure. The same as in study 1.

Data Analysis Methods

- K-means clustering (with elbow method and silhouette scores)
- Kruskal Wallis H-test, Dunn tests with Bonferroni correction
- Regression analysis with a moderator

Results: RQ1

Study 1



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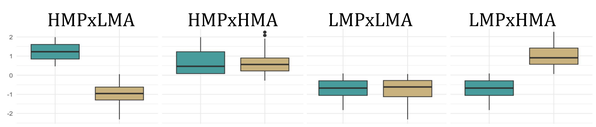

Difference in math performance / math anxiety:

	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	– 4.5*** / 17.7***		
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LMPxLMA	16.3 *** / 16.2***	20.6*** / – 3.2 (p = .2)	– 2.4 (p = .05) / 21.2***

Both studies showed 4 distinct clusters:

- High Math Performance, How Math Anxiety (HMPxLMA): study 1 n=205, study 2 n=130
- High Math Performance, High Math Anxiety (HMPxHMA): study 1 n=225, study 2 n=120
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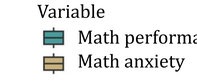

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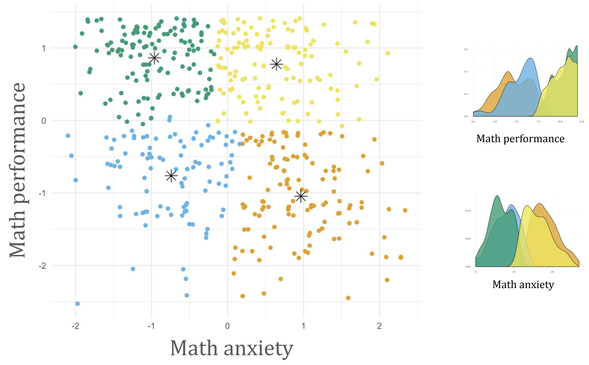
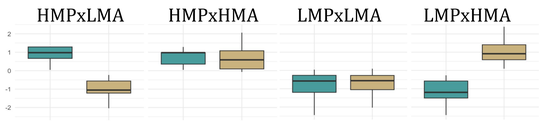
Study 2



Differences in performance were similar to Study 1, except that high-performing clusters did not differ in performance. Differences in anxiety were similar to Study 1.



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LMPxLMA	11.4*** / 10.5***	12.4***/ – 1.7 (p=.3)	– 1.8 (p=.2) / 13.0***

Results: RQ2

All clusters significantly differed in their self-efficacy.

Difference in math self-efficacy (MSE):

	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	–10.2***		
LMPxHMA	6.9***	17.5***	–
LMPxLMA	–2.8 (p=.02)	8.4***	–10.6 (p = .003)

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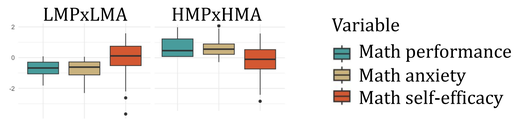

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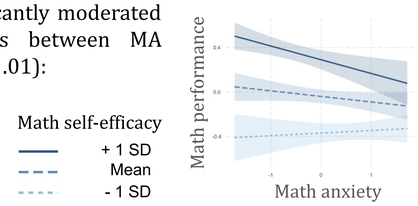

Conclusions

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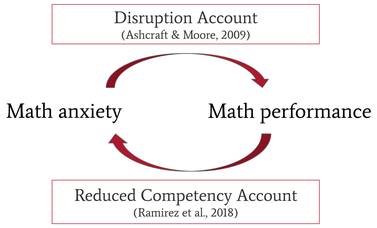

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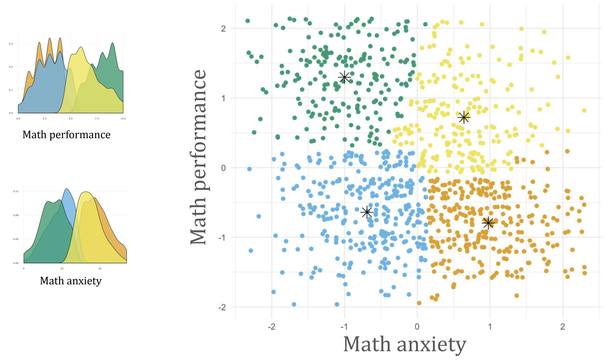

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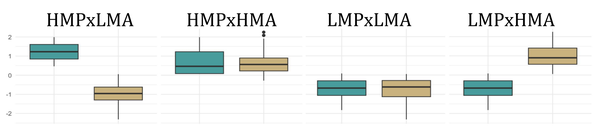

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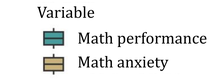

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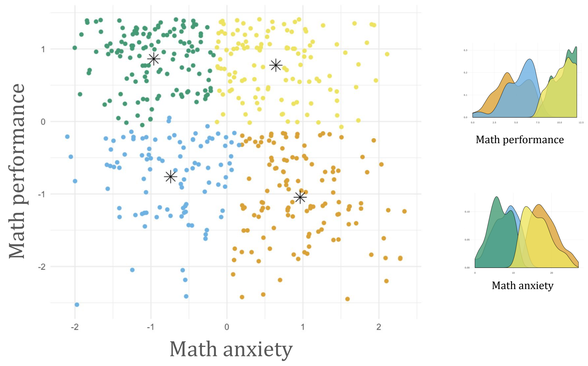

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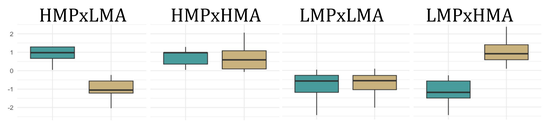

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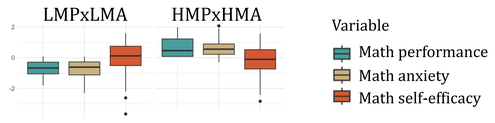

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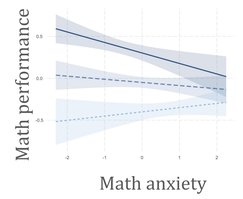

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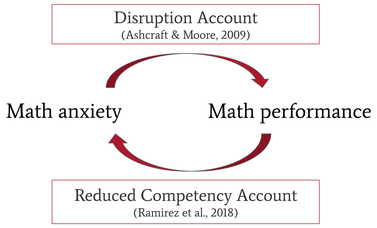

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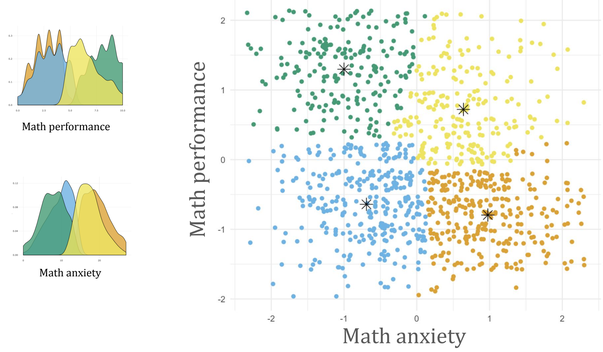

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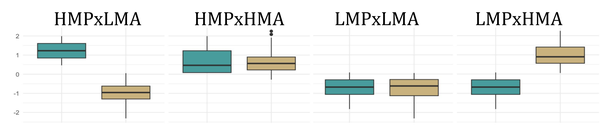

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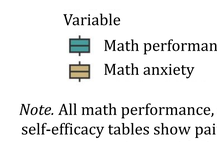

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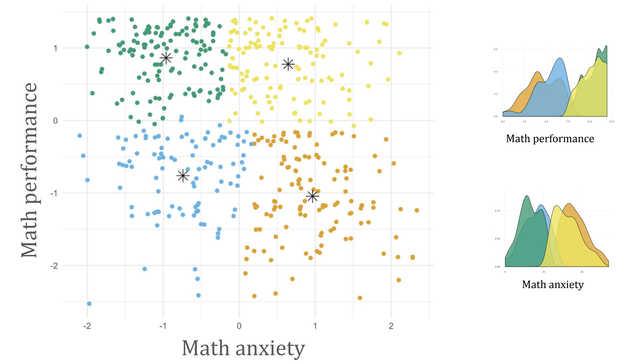

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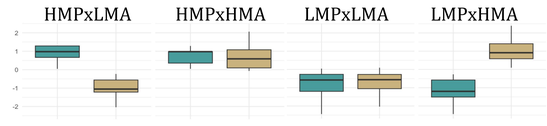

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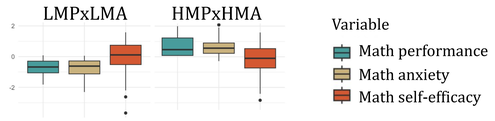

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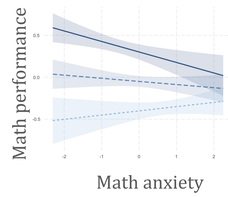

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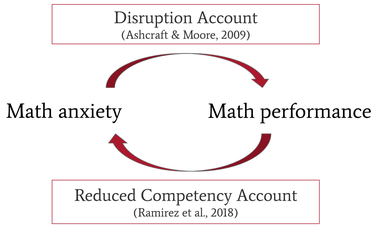

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Math performance. Items adapted from Star et al. (2015): 4 – conceptual understanding in algebra, 3 – procedural knowledge, and 3 – math flexibility (see osf.io/bafdr). No feedback was given.

Math anxiety. Math Anxiety Scale for Young Children-R (Ganley & McGraw, 2016).

Math self-efficacy. Academic Efficacy subscale of the Patterns of Adaptive Learning Scales (Midgley et al., 2000) adapted for math.

Study 2

Participants. 473 6th grade students from 14 US schools. 49% girls, 85% White, 5% Multi-racial, 3% Black, 3% Hispanic/Latino.

Methodology. Online survey administered during the math class time across 2023-24 school year. All students were in person.

Math performance. 12 order-of-operations problems (Joseph, 2014). No feedback was given.

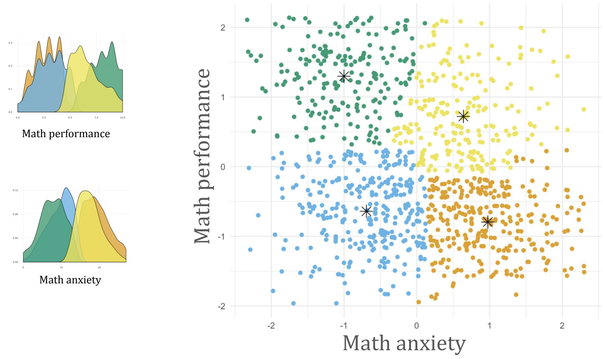
Math anxiety measure. The same as in study 1.

Approach to clustering analysis

First, we standardized values using z-scores. To chose the number of clusters, we used elbow method and silhouette scores. We applied k-means for clustering.

Results: RQ1

Study 1



Both studies showed 4 distinct clusters:

- High performance, low anxiety (HMPxLMA): study 1 *n*=205, study 2 *n*=130
- High performance, high anxiety (HMPxHMA): study 1 *n*=225, study 2 *n*=120
- Low performance, low anxiety (LMPxLMA): study 1 *n*=314, study 2 *n*=98
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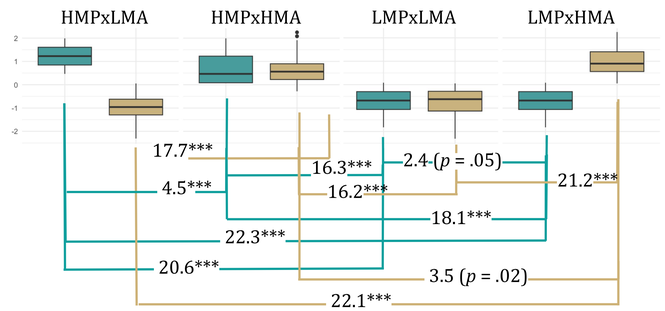
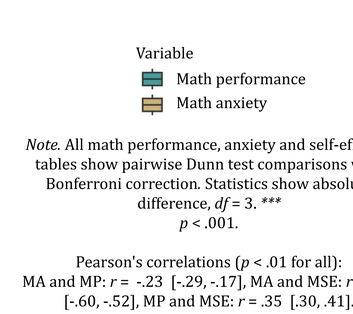
All clusters significantly differed in performance.
Only low anxious clusters did not significantly differed in anxiety.





Note. All math performance, anxiety and self-efficacy tables show pairwise Dunn test comparisons with Bonferroni correction. Statistics show absolute difference, *df* = 3. *** *p* < .001.

Pearson's correlations (*p* < .01 for all):
MA and MP: *r* = -.23 [-.29, -.17], MA and MSE: *r* = -.56 [-.60, -.52], MP and MSE: *r* = .35 [.30, .41].

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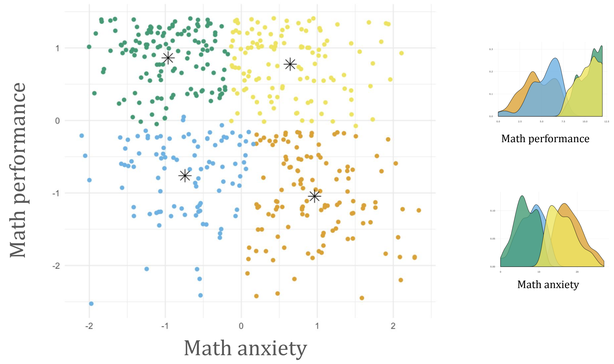
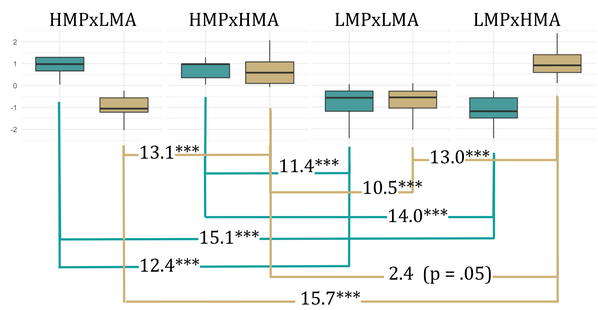


Less significant differences in performance between clusters.
Differences in anxiety were similar to study 1.



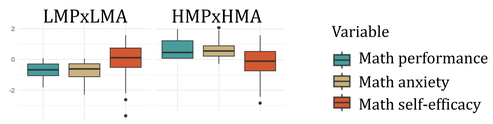
Results: RQ2

All clusters significantly differed in their self-efficacy.

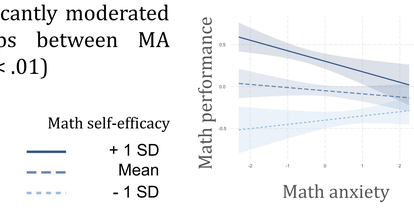
Difference in math self-efficacy (MSE):

	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	−9.6***		
LMPxHMA	6.0***	16.0***	–
LMPxLMA	−2.8***	7.7***	−9.6 (*p* = .003)

Cluster with low performance and low anxiety showed slightly but significantly higher level of math self-efficacy then cluster with high performance and high anxiety:



MSE significantly moderated relationships between MA and MP (*p* < .01)



Conclusions

- Clustering showed the extent to which students tend to deviate from traditional linear perspective on association between math performance (MP) and math anxiety (MA) and two directions of this deviation.
- In about one fourth of students, high MA did not prevent students from showing high levels of MP. However, in Study 1, those students demonstrated significantly lower performance compared to high performing low anxious students – supporting the idea that high anxiety can prevent students from performing on the highest level.
- Deviation from reduced competency account theory in another quarter of participants can be associated with their difference in self-efficacy, signaling that students from this cluster could overestimate their math abilities and, thus, not increase in negative feelings around math.
- These findings highlight importance for searching and always accounting for moderation variables when aiming to predict performance from anxiety and vice versa.

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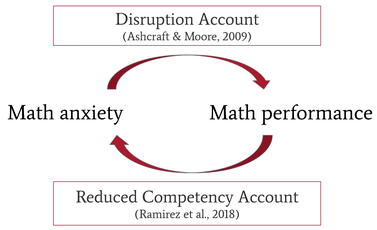
QR code

Person-Oriented Approach to Math Anxiety, Math Performance and Math Self-Efficacy Associations

Alena Egorova, Stacy T. Shaw, Ji-Eun Lee, Erin Ottmar
Worcester Polytechnic Institute

Background & Research Questions

Research shows that anxiety in mathematics negatively correlates with mathematics performance:



Some studies examined potential moderators in these relationships, showing that some highly math anxious students still perform well in mathematics (Ramirez et al., 2018). However, few studies examine how often students diverge from this linear relationships and which other variables can explain potential deviation from reduced competency account theory.

RQ1 How many groups will emerge if we cluster students based on their math anxiety and performance?
RQ2 How students from those clusters differ in math anxiety, performance, and self-efficacy?

Study 1

Participants. 1,029 students in 7th grade (typically 13-14-year-olds) from 11 US schools. 47% girls, 50% White, 27% Asian, 16% Hispanic/Latino, 7% Other.

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Math performance measure. Items adapted from Star et al. (2015): 4 – conceptual understanding in algebra, 3 – procedural knowledge, and 3 – math flexibility (see osf.io/bafdr). No feedback was given.

Math anxiety measure. Math Anxiety Scale for Young Children-R (Ganley & McGraw, 2016).

Math self-efficacy. Academic Efficacy subscale of the Patterns of Adaptive Learning Scales (Midgley et al., 2000) adapted for math.

Study 2

Participants. 473 6th grade students from 14 US schools. 49% girls, 85% White, 4.9% Multi-racial, 2.7% Black, 2.7% Hispanic/Latino.

Methodology. Online survey administered during the math class time across 2023-24 school year. All students participated in person.

Math performance measure: 12 order-of-operations problems (Joseph, 2014). No feedback was given.

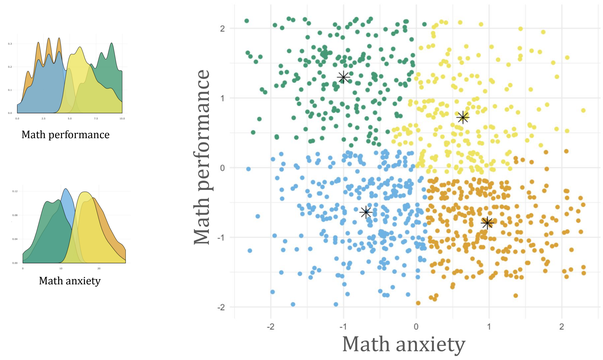
Math anxiety measure: The same as in study 1.

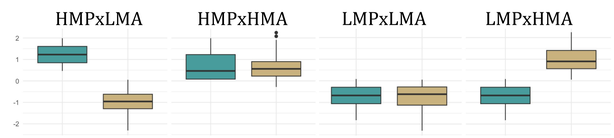
Approach to clustering analysis

First, we standardized anxiety and performance using z-scores. To chose the number of clusters, we used elbow method and silhouette scores. Then, we applied k-means clustering with 4 centers.

Results: RQ1

Study 1





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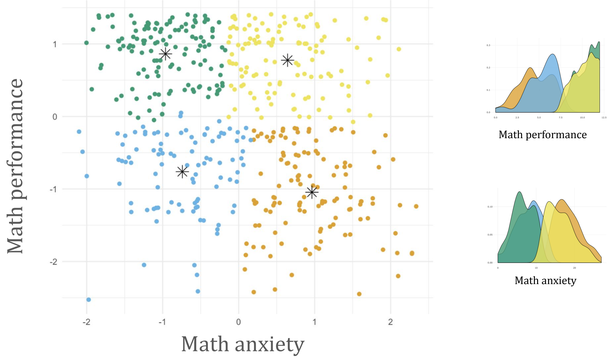
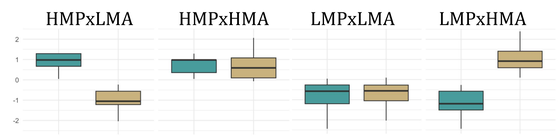
Variable
Math performance
Math anxiety

Study 2





	Difference in math performance:			Difference in math anxiety:		
	HMPxHMA	HMPxLMA	LMPxHMA	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	– 4.5***			17.7***		
LMPxHMA	18.1 ***	22.3***	–	– 3.5 (p = .02)	– 22.1***	–
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Note. All math performance, anxiety and self-efficacy tables show pairwise Dunn test comparisons with Bonferroni correction. Statistics show column mean minus row mean, df = 3. *** p < .001.

Results: RQ2

Correlational matrix

	Math perform.	Math anxiety
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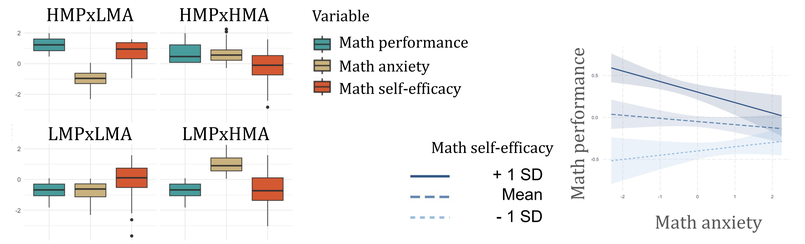

Conclusions

- Clustering showed the extent to which students deviate from traditional linear perspective on association between math performance (MP) and math anxiety (MA) and directions of this deviation.
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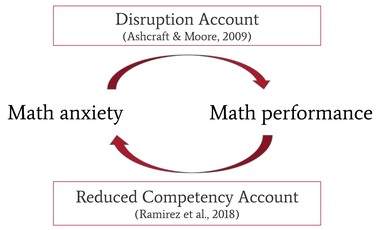

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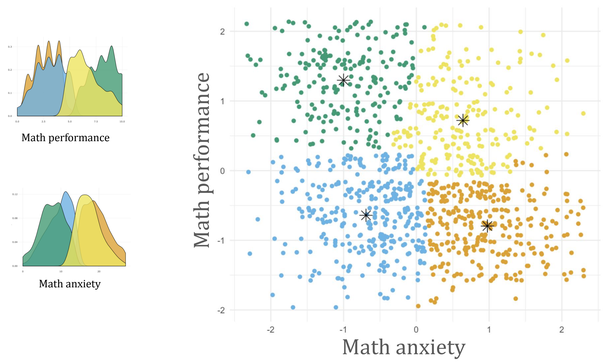

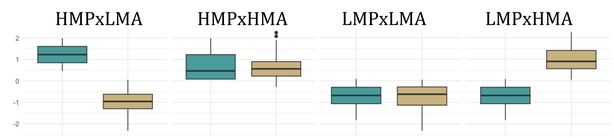

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Variable
Math performance
Math anxiety

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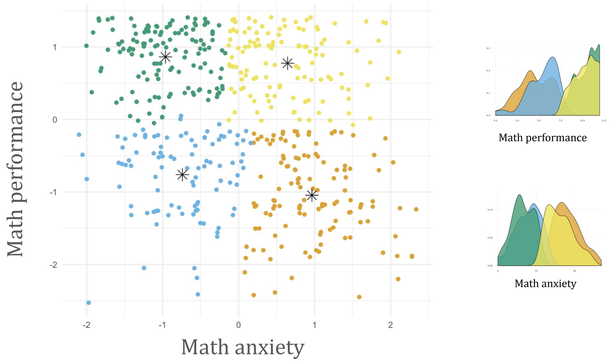

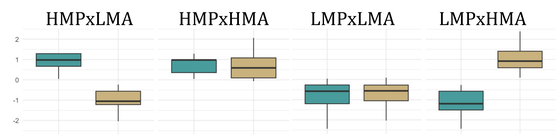

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Results: RQ2

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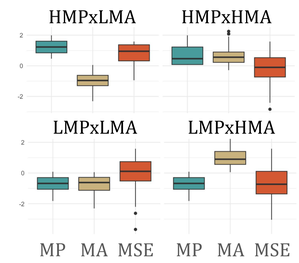

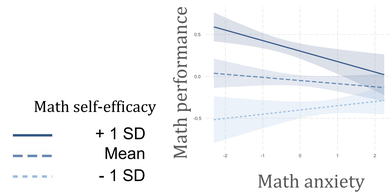

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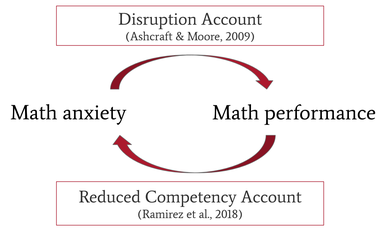

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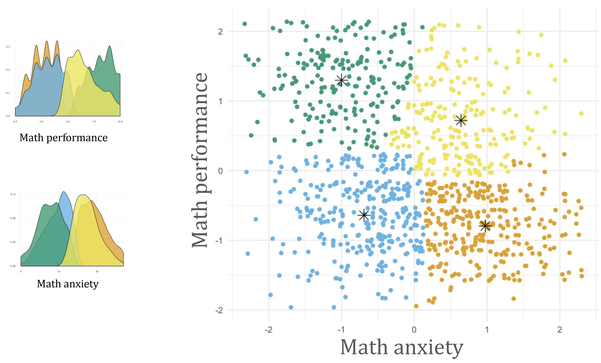

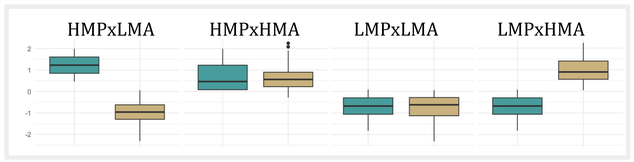

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Variable
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Math anxiety

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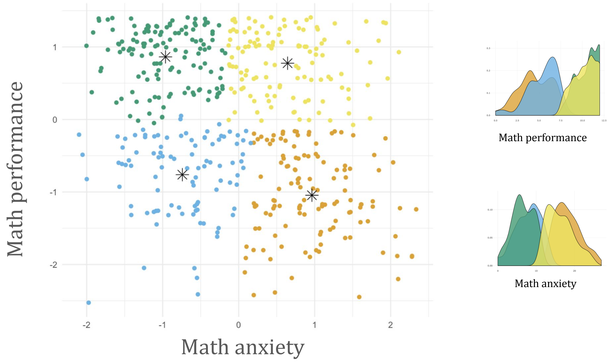

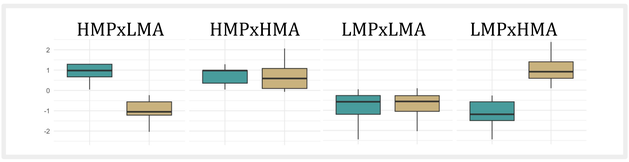

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LMPxHMA	14.0***	15.1***	–	– 2.4 (p = .05)	– 15.7***	–
LMPxLMA	11.4***	12.4***	– 1.8 (p = .2)	10.5***	– 1.7 (p = .3)	13.0***

Note. All math performance, anxiety and self-efficacy tables show pairwise Dunn test comparisons with Bonferroni correction. Statistics show column mean minus row mean, df = 3. *** p < .001.

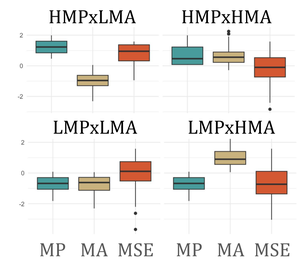
Results: RQ2

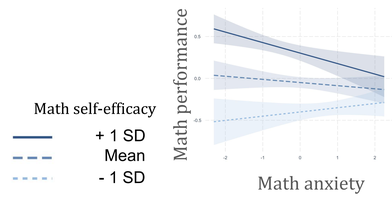
Correlational matrix

	Math perform.	Math anxiety
Math anxiety	-.23** [-.29, -.17]	–
Math self-efficacy	.35** [.30, .41]	-.56** [-.60, -.52]

Difference in math self-efficacy (MSE):

	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	–9.6***		
LMPxHMA	6.0***	16.0***	–
LMPxLMA	–2.8***	7.7***	–9.6 (p = .003)





Conclusions

- Clustering showed the extent to which students deviate from traditional linear perspective on association between math performance (MP) and math anxiety (MA) and directions of this deviation.
- About one fourth of students showed high levels of MP and MA. In Study 1, performance of this cluster was significantly lower compared to high performing low anxious students – supporting the idea that high anxiety can prevent students from performing on the highest level.
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- These findings highlight importance for searching and always accounting for moderation variables when aiming to predict performance from anxiety and vice versa.

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This poster, code analysis and more details

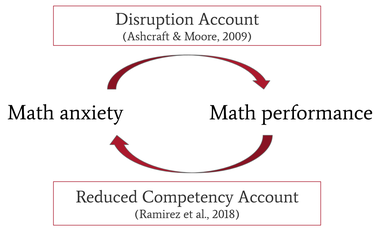
QR code

Person-Oriented Approach to Math Anxiety, Math Performance and Math Self-Efficacy Associations

Alena Egorova, Stacy T. Shaw, Ji-Eun Lee, Erin Ottmar
Worcester Polytechnic Institute

Background & Research Questions

Research shows that anxiety in mathematics negatively correlates with mathematics performance:



Some studies examined potential moderators in these relationships, showing that some highly math anxious students still perform well in mathematics (Ramirez et al., 2018). However, few studies examine how often students diverge from this linear relationships and which other variables can explain potential deviation from reduced competency account theory.

RQ1 How many groups will emerge if we cluster students based on their math anxiety and performance?
RQ2 How students from those clusters differ in math anxiety, performance, and self-efficacy?

Study 1

Participants. 1,029 students in 7th grade (typically 13-14-year-olds) from 11 US schools. 47% girls, 50% White, 27% Asian, 16% Hispanic/Latino, 7% Other.

Methodology. Online survey administered by teachers during math class across 2020-21 school year. A total of 76% of students attended class in person, others – remotely.

Math performance measure. Items adapted from Star et al. (2015): 4 – conceptual understanding in algebra, 3 – procedural knowledge, and 3 – math flexibility (see osf.io/bafdr). No feedback was given.

Math anxiety measure. Math Anxiety Scale for Young Children-R (Ganley & McGraw, 2016).

Math self-efficacy. Academic Efficacy subscale of the Patterns of Adaptive Learning Scales (Midgley et al., 2000) adapted for math.

Study 2

Participants. 473 6th grade students from 14 US schools. 49% girls, 85% White, 4.9% Multi-racial, 2.7% Black, 2.7% Hispanic/Latino.

Methodology. Online survey administered during the math class time across 2023-24 school year. All students participated in person.

Math performance measure: 12 order-of-operations problems (Joseph, 2014). No feedback was given.

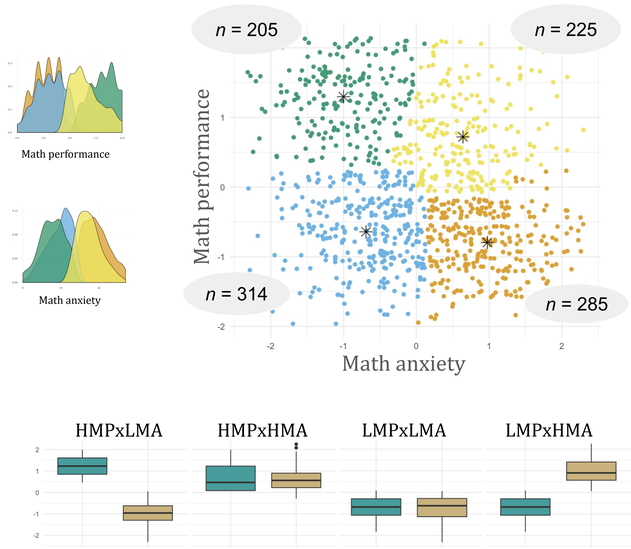
Math anxiety measure: The same as in study 1.

Approach to clustering analysis

First, we standardized anxiety and performance using z-scores. To chose the number of clusters, we used elbow method and silhouette scores. Then, we applied k-means clustering with 4 centers.

Results: RQ1

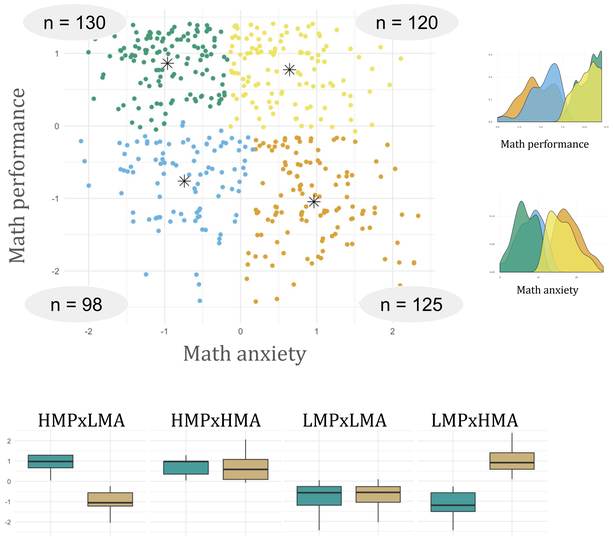
Study 1



Clusters
- High performance, low anxiety (HMPxLMA)
- High performance, high anxiety (HMPxHMA)
- Low performance, low anxiety (LMPxLMA)
- Low performance, high anxiety (LMPxHMA)

Variable
- Math performance
- Math anxiety

Study 2



	Difference in math performance:			Difference in math anxiety:		
	HMPxHMA	HMPxLMA	LMPxHMA	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	– 4.5***			17.7***		
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Results: RQ2

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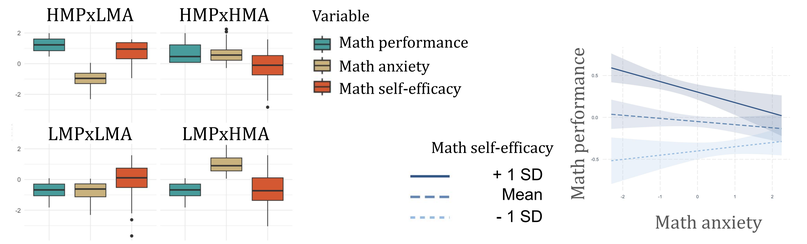

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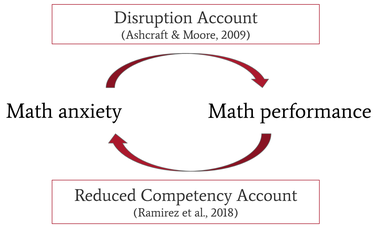

Some studies examined potential moderators in these relationships, showing that some highly math anxious students still perform well in mathematics (Ramirez et al., 2018). However, few studies examine how often students diverge from this linear relationships and which other variables can explain potential deviation from reduced competency account theory.

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Participants. 1,029 students in 7th grade (typically 13-14-year-olds) from 11 US schools. 47% girls, 50% White, 27% Asian, 16% Hispanic/Latino, 7% Other.

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Math anxiety. Math Anxiety Scale for Young Children-R (Ganley & McGraw, 2016).

Math self-efficacy. Academic Efficacy subscale of the Patterns of Adaptive Learning Scales (Midgley et al., 2000) adapted for math.

Study 2

Participants. 473 6th grade students from 14 US schools. 49% girls, 85% White, 5% Multi-racial, 3% Black, 3% Hispanic/Latino.

Methodology. Online survey administered during the math class time across 2023-24 school year. All students were in person.

Math performance. 12 order-of-operations problems (Joseph, 2014). No feedback was given.

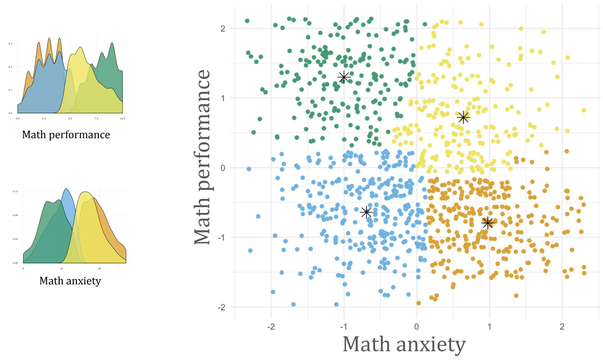
Math anxiety measure. The same as in study 1.

Approach to clustering analysis

First, we standardized values using z-scores. To chose the number of clusters, we used elbow method and silhouette scores. We applied k-means for clustering.

Results: RQ1

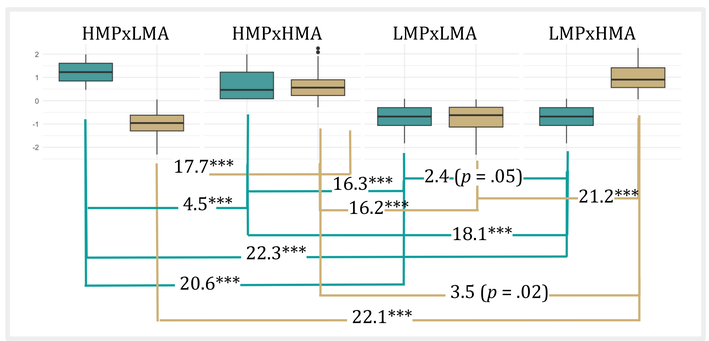
Study 1

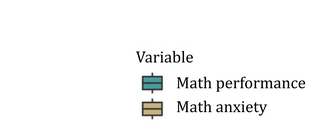


Both studies showed 4 distinct clusters:

- High performance, low anxiety (HMPxLMA): study 1 *n*=205, study 2 *n*=130
- High performance, high anxiety (HMPxHMA): study 1 *n*=225, study 2 *n*=120
- Low performance, low anxiety (LMPxLMA): study 1 *n*=314, study 2 *n*=98
- Low performance, high anxiety (LMPxHMA): study 1 *n*=285, study 2 *n*=125

All clusters significantly differed in performance.
Only low anxious clusters did not significantly differed in anxiety.

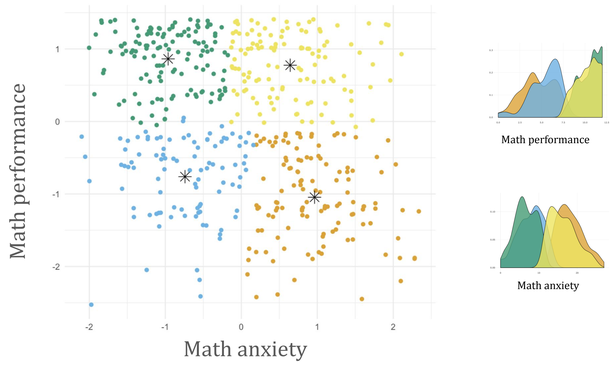




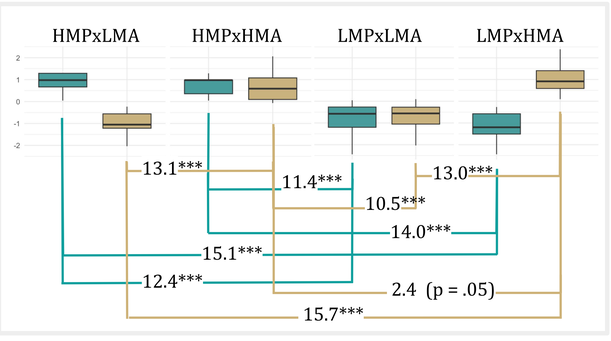
Note. All math performance, anxiety and self-efficacy tables show pairwise Dunn test comparisons with Bonferroni correction. Statistics show absolute difference, *df* = 3. *** *p* < .001.

Pearson's correlations (*p* < .01 for all):
MA and MP: *r* = -.23 [-.29, -.17], MA and MSE: *r* = -.56 [-.60, -.52], MP and MSE: *r* = .35 [.30, .41].

Study 2



Less significant differences in performance between clusters.
Differences in anxiety were similar to study 1.



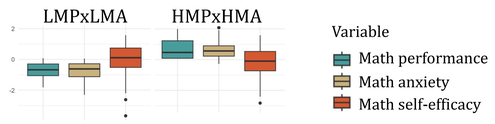
Results: RQ2

All clusters significantly differed in their self-efficacy.

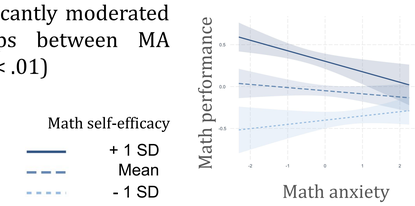
Difference in math self-efficacy (MSE):

	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	−9.6***		
LMPxHMA	6.0***	16.0***	–
LMPxLMA	−2.8***	7.7***	−9.6 (*p* = .003)

Cluster with low performance and low anxiety showed slightly but significantly higher level of math self-efficacy then cluster with high performance and high anxiety:



MSE significantly moderated relationships between MA and MP (*p* < .01)



Conclusions

- Clustering showed the extent to which students deviate from traditional linear perspective on association between math performance (MP) and math anxiety (MA) and directions of this deviation.
- In about one fourth of students, high MA did not prevent students from showing high levels of MP. However, in Study 1, those students demonstrated significantly lower performance compared to high performing low anxious students – supporting the idea that high anxiety can prevent students from performing on the highest level.
- Deviation from reduced competency account theory in another quarter of participants can be associated with their difference in self-efficacy, signaling that students from this cluster could overestimate their math abilities and, thus, not increase in negative feelings around math.
- These findings highlight importance for searching and always accounting for moderation variables when aiming to predict performance from anxiety and vice versa.

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Person-Oriented Approach to Math Anxiety, Math Performance and Math Self-Efficacy Associations

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Worcester Polytechnic Institute

Background & Research Questions

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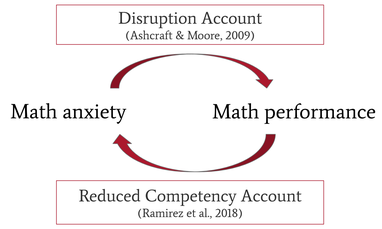

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RQ2 How students from those clusters differ in math anxiety, performance and self-efficacy?

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Participants. 1,029 students in 7th grade (typically 13-14-year-olds) from 11 US schools. 47% girls, 50% white, 27% asian, 16% hispanic/latino, 7% other races.

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Math performance measure. Items adapted from Star et al. (2015): 4 – conceptual understanding in algebra, 3 – procedural knowledge, and 3 – math flexibility (see osf.io/bafdr). No feedback was given.

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Approach to clustering analysis

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Results: RQ1

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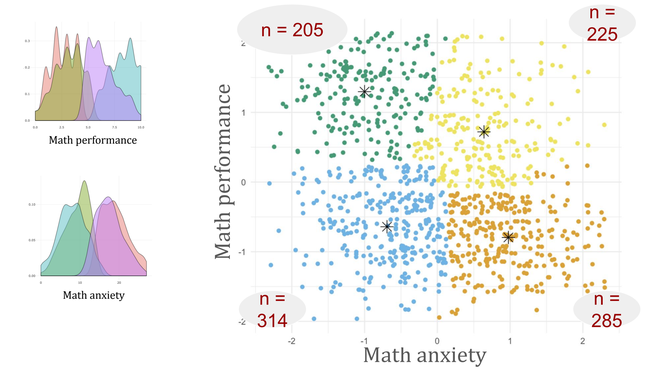


Clusters
- High performance, low anxiety (HMPxLMA)
- High performance, high anxiety (HMPxHMA)
- Low performance, low anxiety (LMPxLMA)
- Low performance, high anxiety (LMPxLMA)

Variable: Math performance, Math anxiety

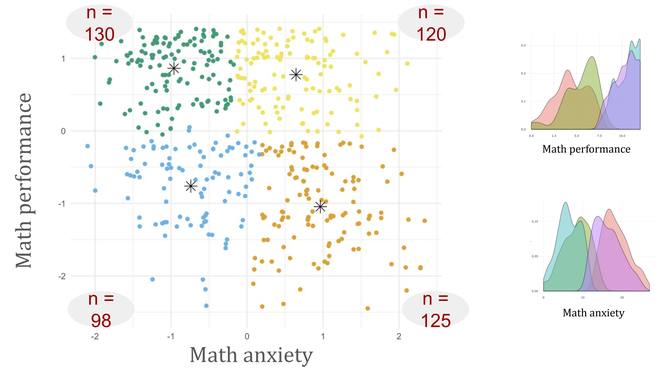
Difference in math performance:

	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	– 4.5***		
LMPxHMA	18.1 ***	22.3***	–
LMPxLMA	16.3 ***	20.6***	– 2.4 (p = .05)

Difference in math anxiety:

	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	17.7***		
LMPxHMA	– 3.5 (p = .02)	– 22.1***	–
LMPxLMA	16.2***	– 3.2 (p = .2)	21.2***

Study 2



Difference in math performance:

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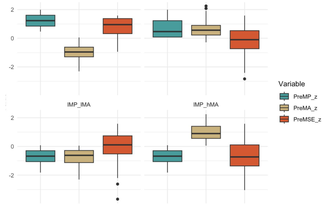
LMPxLMA	10.5***	– 1.7 (p = .3)	13.0***

Note. All tables show pairwise Dunn test comparisons with Bonferroni *correction.* Statistics show column mean minus row mean, df = 3. *** $p < .001$.

Results: RQ2

Correlational matrix

Cluster \ Cluster	Math performance	Math anxiety
Math anxiety	-.23** [-.29, -.17]	–
Math self-efficacy	.35** [.30, .41]	-.56** [-.60, -.52]



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LMPxLMA	–2.8***	7.7***	–9.6 (p = .003)

*Note. P*airwise Dunn test comparisons with Bonferroni *correction.*
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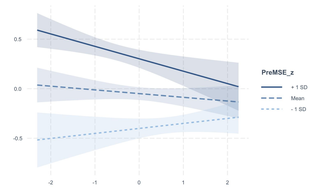

Conclusions

- Clustering approach helped highlight the extent to which students deviate from traditional linear perspective on association between math performance and anxiety. In two studies, students were grouped into 4 distinct clusters – while 2 clusters were in accordance with traditional negative linear perspective, about half of students showed pattern of another sort.
- About one fourth of students showed high levels of math performance and anxiety. In the first study, performance of this cluster was significantly lower compared to high performing low anxious students – supporting the idea that high anxiety can prevent students from performing on the highest level. Potential ceiling effect in performance can lead to this cluster not showing decreased performance in the second study.
- The last cluster - also about one fourth of students - show relatively low levels of math performance and anxiety – not significantly different levels of anxiety compared to cluster with the highest performance. Moreover, this cluster demonstrated slightly but significantly higher levels of math self-efficacy compared to higher performing higher anxious students, signaling that students from this cluster could misjudge their math abilities and, thus, not increase in negative feelings around math.
- This findings highlight importance for searching and always accounting for moderation variables when aiming to predict performance from anxiety and vice versa. Specifically, more research is needed to explore what helps students from high performance high anxiety cluster perform relatively well in math and why some students not increase in anxiety even showing

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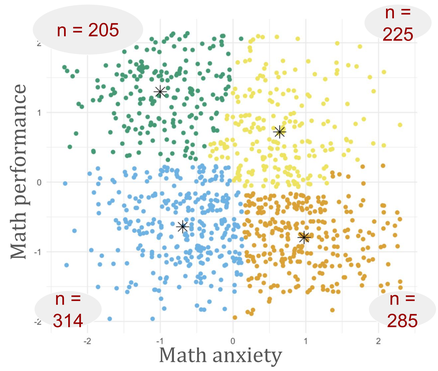

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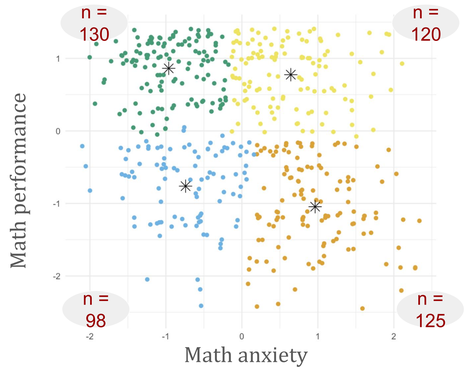
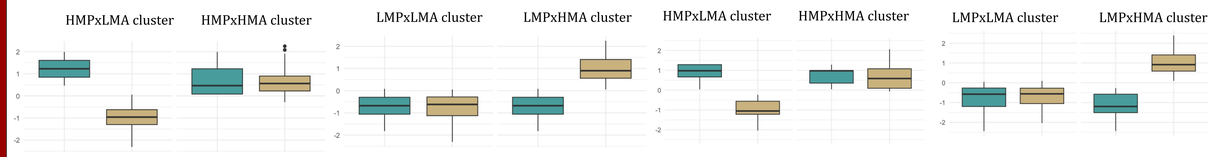
Study 2





Variable
- Math performance
- Math anxiety

Statistical difference in math performance:
pairwise Dunn test comparisons with Bonferroni correction

Cluster \ Cluster	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	– 4.5 (p < .001)		
LMPxHMA	18.1 (p < .001)	22.3 (p < .001)	–
LMPxLMA	16.3 (p < .001)	20.6 (p < .001)	– 2.4 (p = .052)

Statistical difference in math performance:
pairwise Dunn test comparisons with Bonferroni correction

Cluster \ Cluster	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	– 0.9 (p = 1.00)		
LMPxHMA	14.0 (p < .001)	15.1 (p < .001)	–
LMPxLMA	11.4 (p < .001)	12.4 (p < .001)	– 1.8 (p = .226)

Statistical difference in math anxiety:
pairwise Dunn test comparisons with Bonferroni correction

Cluster \ Cluster	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	17.7 (p < .001)		
LMPxHMA	– 3.5 (p = .019)	– 22.1 (p < .001)	–
LMPxLMA	16.2 (p < .001)	– 3.2 (p = .147)	21.2 (p < .001)*

Statistical difference in math anxiety:
pairwise Dunn test comparisons with Bonferroni correction

Cluster \ Cluster	HMPxHMA	HMPxLMA	LMPxHMA
HMPxLMA	13.1 (p < .001)		
LMPxHMA	– 2.4 (p = .050)	– 15.7 (p < .001)	–
LMPxLMA	10.5 (p < .001)	– 1.7 (p = .261)	13.0 (p < .001)*

Note. Statistics show column mean minus row mean, df = 3.

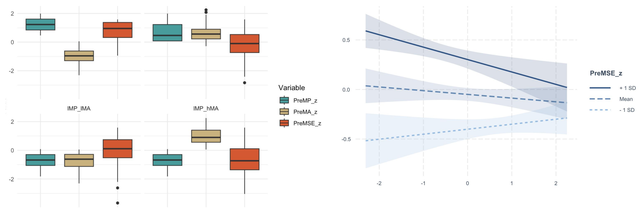
Results: RQ2

Correlational matrix

Cluster \ Cluster	Math performance	Math anxiety
Math anxiety	-.23** [-.29, -.17]	–
Math self-efficacy	.35** [.30, .41]	-.56** [-.60, -.52]

Statistical difference in math self efficacy:
pairwise Dunn test comparisons with Bonferroni correction

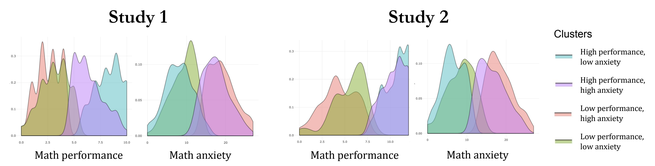
Cluster \ Cluster	HMPxHMA	HMPxLMA	LMPxHMA	LMPxLMA
HMPxLMA	−9.6 (p < .001)			
LMPxHMA	6.0 (p < .001)	16.0 (p < .001)	–	
LMPxLMA	−2.8 (p < .001)	7.7 (p < .001)	−9.6 (p = .003)	–



Approach to clustering analysis

We standardized anxiety and performance using z-scores.
We decided on the number of clusters based on elbow method and silhouette scores ().
We applied k-means clustering.

Anxiety and performance distributions



Conclusions

- Clustering approach helped highlight the extent to which students deviate from traditional linear perspective on association between math performance and anxiety. In two studies, students were grouped into 4 distinct clusters – while 2 clusters were in accordance with traditional negative linear perspective, about half of students showed pattern of another sort.
- About one fourth of students showed high levels of math performance and anxiety. In the first study, performance of this cluster was significantly lower compared to high performing low anxious students – supporting the idea that high anxiety can prevent students from performing on the highest level. Potential ceiling effect in performance can lead to this cluster not showing decreased performance in the second study.
- The last cluster - also about one fourth of students - show relatively low levels of math performance and anxiety – not significantly different levels of anxiety compared to cluster with the highest performance. Moreover, this cluster demonstrated slightly but significantly higher levels of math self-efficacy compared to higher performing higher anxious students, signaling that students from this cluster could misjudge their math abilities and, thus, not increase in negative feelings around math.
- This findings highlight importance for searching and always accounting for moderation variables when aiming to predict performance from anxiety and vice versa. Specifically, more research is needed to explore what helps students from high performance high anxiety cluster perform relatively well in math and why some students not increase in anxiety even showing lower performance.

Funding

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A180401 (study 1) and the National Science Foundation, through an ECR Core grant (2300764) to WPI (study 2). Travel grant for attending this presentation was awarded to Alena Egorova by …

This poster, code analysis and more details

QR code

To correlate or not to correlate? Math anxiety and performance relationships

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Background & Research Questions

- Rest, leisure, and breaks should be a *right*, but they are often a *privilege* [1].
  - For example, rest is fundamental to human learning and memory [2, 3, 4] and leisure engagement is bidirectionally linked to subjective well-being [5].
- Students who are first-generation (FG), community college transfer students (TS), and international students (INT) may face additional barriers to resting in college [6, 7, 8] as they can face additional pressures and stressors [9].
- Postsecondary institutions have encouraged students to rest through formal initiatives, but little is known as to whether these initiatives are actually effective in (1) encouraging student rest and (2) creating a culture where rest is valued.
- Researchers explored FG, TS, and INT perspectives on the WPI campus given its unique challenges to rest, culture as a competitive STEM-focused university, and increased efforts to improve mental health of its students.

RQ1) *What unique obstacles prevent underrepresented students from getting rest?*
RQ2) *What do these students believe is the purpose of a "Wellness Day"?*
RQ3) *What suggestions do these students have for WPI to improve work-rest balance?*

Participants & Methodology

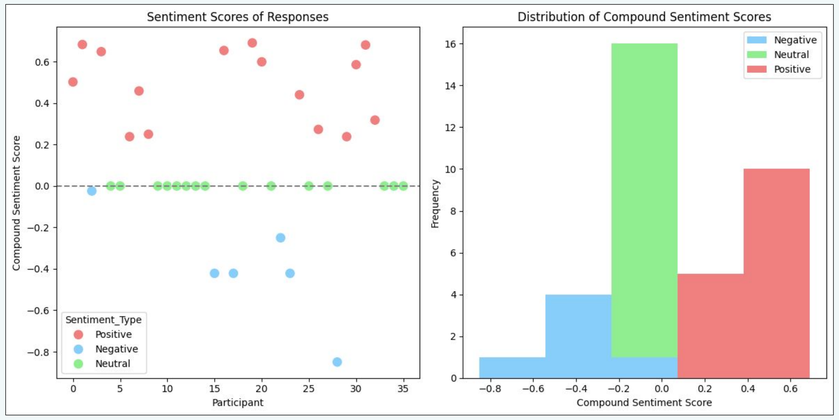
- First-generation, transfer, and international WPI students (*n*=36).
- The total sample had an average age of 20.89; *n*=20 female, 12 male, 2 non-binary, 2 non specified; *n*=16 Asian (broad), *n*=11 White, *n*=5 Hispanic, *n*=2 African, and *n*=2 White/Hispanic.
- Online survey administered during the 2022-23 school year.
- Inductive Thematic Content Analysis [10] among three raters to develop codes representing overarching themes in responses.
- Natural Language Processing (Sentiment Analysis using VADER) to gauge overall student attitudes toward the purpose of Wellness Day.

RQ1) What specific obstacles do students face to engaging in rest?

- Internal struggles (52.7%) and pressure to succeed (38.8%)
- Educational background and academics (22.2%)
- Adjustment to campus (36.1%)
- Family's lack of understanding (19.4%) and support (11.1%)
- Financial stress (33.3%) and employment (13.8%)
- Guilt (13.8%)

RQ2) What do you think the purpose of WPI Wellness Day is?

Sentiment Analysis: Participant responses about Wellness Day ranged from negative to positive sentiment, but were neutral on average.



Theme 1: Rest (63.8%)

Participants explicitly mentioned rest or implied it is a day for students to recharge and enjoy themselves.

*"Give students a chance to **rest and relax**"*
*"To take a moment to **step back, reflect, and recharge**."*

Theme 2: Studying (38.8%)

Participants mentioned catching up on work, studying for classes, doing work to stay on top of academics; extra time to get work done.

*"Honestly it is just a day without lecture, we still have **tons of work.**"*

Theme 3: Misuse (33.3%)

Participants mentioned the a distinction between perceived purpose and the actual use by themselves or the student body.

*"It is **marketed as a day to legitimately rest** and recharge. I use it as a day to **catch up** on all the work that needs to be done."*

Theme 4: Break from Work (27.7%)

Participants mentioned taking a break or a step back from work.

*"To give students a **'break'** or at the very least a day to catch up…"*
*"To make sure that students can **take breaks and refocus**"*

Theme 5: Awareness of Wellness Practices (22.2%)

Participants mentioned an opportunity for the institution to demonstrate why rest is important and offer reflection; mindfulness.

*"To rest and to **acknowledge the importance of de-stressing** and self care habits."*

RQ3) What is one academic factor that WPI can change to improve work/rest?

- **Theme 1: Faculty Accountability (39.3%)**
- **Theme 2: Respect for Student Wellness (27.2%)**
- **Theme 3: Change of Schedule (18.1%)**
- **Theme 4: Promoting Rest (18.1%)**
- **Theme 5: Less Work (15.1%)**
- **Theme 6: Organizational Support (15.1%)**
- **Theme 7: Campus Resources (15.1%)**

Discussion

- FG, TS, and INT students face unique challenges to engage in rest, and therefore need unique supports to engage in rest consistently and without guilt. Our data suggest:
  - Institutional advocacy for flexible faculty that can empathize with students.
  - Stricter adherence to recommended hours of work (e.g. course adjustments).
  - Iterative feedback on Wellness Days and avoiding tight deadlines near the day.
  - Campus support groups for FG, TS, and INT students that attend to their needs.

Acknowledgments + Funding

Thanks to Paul Pacheco for his efforts with data collection on this project.

Funding: These data were collected with the support of a WPI DEIJ Seed grant awarded to Shaw, Skorinko, Kmiotek, Callahan-Panday, and Fitzpatrick and the first and second author were funded by an NSF REU grant #1950683.

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