



Developmental Trajectories During Doctoral Study: Identifying Heterogeneity in Psychosocial Factor's Development

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Motivation

- Doctoral education is central to the research enterprise
- Limited research related to the developmental process that students experience during their doctoral education
- Most research on doctoral student development is based on Weidman's socialization model (Feldon, 2020; Gardner, 2010):
 - Identify socialization experiences that support or hinder doctoral student development
- Weidman's socialization model does not show how doctoral students internalize the dispositions for developing a scholarly identity
- Research has highlighted the importance psychosocial characteristics in scholarly identity formation (Carlone & Johnson, 2007; Garcia, 2013)
- Self-determination theory (SDT, Deci & Ryan, 2000) and identity development theory (Carlone & Johnson, 2007; Gee, 2000) help to illuminate this process

Research Questions

1. What are the developmental trajectories of doctoral students in their first years in the program according to their psychosocial characteristics?
2. What sociodemographic characteristics and pre-doctoral experiences are associated with membership to each developmental trajectory?
3. Are these developmental trajectories associated with selected intermediate socialization outcomes?

A group of five people are seated around a dark conference table in a meeting room. On the left, a man with glasses and a plaid shirt is smiling. Next to him, a woman with blonde hair is seen from the side, looking towards the center. In the middle, a man in a plaid shirt is writing on a notepad. Opposite him, a woman with glasses and a name tag is smiling. On the far right, a man with glasses is looking towards the center. The table is covered with papers, a water bottle, and a coffee cup. In the background, there is a coffee machine and a shelf with various items. The entire image has a dark blue overlay.

Review of the Literature

Psychosocial factors associated with a successful socialization process

- Basic psychological needs (Bair & Haworth, 2004; Kumar & Kaur, 2019; Sakurai et al., 2017; Garcia, 2013)
 - Autonomy in research endeavors
 - Competence in developing essential skills as a scholar
 - Relatedness
 - With faculty members: well-being, learning outcomes, sense of agency, self-esteem, academic membership in disciplines, completion (Protivnak & Foss, 2009; Schwartz & Holloway, 2014; Austin & McDaniels, 2006; Golde, 1998, 2000)
 - With peers: socialization experiences that promote scholarly identity development (Austin, 2002; Golde, 1998)
- Recognition
 - Recognition as a person belonging to the discipline from faculty, peers, and academic community develop a scholarly identity (Carlone & Johnson, 2007; Williams et al., 2018)

Pre-doctoral experiences and social identities

- Anticipatory socialization experiences for increased competence
 - Undergraduate research programs, master's degree in the related field, conference attendance, presentation, publication (Flaster et al., 2020; Gilmore et al., 2015; Gittens, 2014; Luedke et al., 2019)
- Minoritized students' experiences
 - Encounter more negative experiences → under-respected, marginalization, discrimination, tokenism, stereotyping, low expectations, need of proving their values (González, 2006; Margolis & Romero, 1998)
 - More difficult to reconcile professional, relational, and personal identities (Pifer & Baker, 2014)

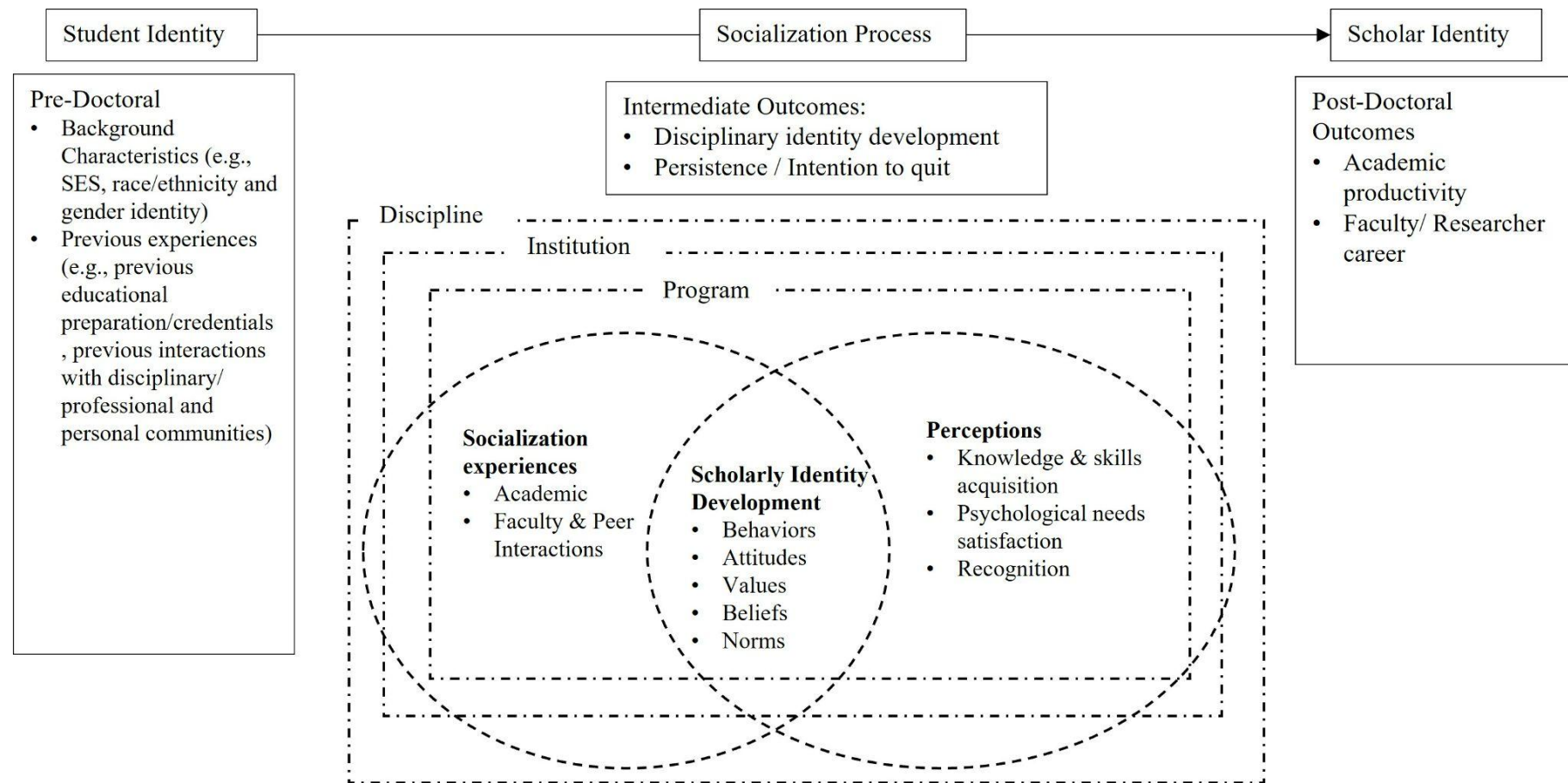
Developmental trajectories in doctoral education

- Doctoral education is a longitudinal process. Support and experiences desired for socialization differ depending on which stage a student is in (Gardner, 2009; Weidman, 2020).
- Person-oriented approach - focus on subgroup identification (Jeong et al., 2020)
 - Limited literature using the person-oriented approach
 - Sample (i.e., Biology), lack of relation to socialization outcomes
- Developmental trajectory - emerge from the data without assuming a predefined trajectory (Nagin, 2005)

A blue-tinted photograph of a group of people sitting around a table in a meeting. A woman in the center has a name tag that reads "Elyse Aurbach, Public Engagement Lead, Office of Academic Innovation, U-M".

Theoretical Framework

Fig. Theoretical framework of doctoral student socialization process



Source: Own elaboration based on Weidman's socialization model (Weidman et al., 2001; Weidman & DeAngelo, 2020), Deci and Ryan's self-determination theory (SDT, Deci & Ryan, 2000), and identity development theory (Carlone & Johnson, 2007; Gee, 2000).

Methods

A blue-tinted photograph of a group of people sitting around a conference table in a meeting room. The people are engaged in discussion, with some looking at papers and others at each other. A name tag on the table identifies 'Elyse Aurbach' as the Public Engagement Lead. The room has a modern feel with a coffee station in the background.

Data & Sample

- Michigan Doctoral Experience Study (MDES)
- Cohorts 2017 and 2018
- 3 measurement times:
 - T1: baseline
 - T2, T3: follow-up surveys applied at the beginning of 2nd and 3rd year
- Analytical sample: only students that participated at least 2 of the 3 times □ n=1,264, 62% of population

	Sample %	Population %
Sociodemographic characteristics:		
Sex:		
Female	52.06	45.59
URM/International status:		
Domestic non-URM	54.43	50.1
URM	14.72	14.31
International	30.85	35.59
First generation college student	19.37	20.95
Academic Field:		
Biological & Health Sciences	25.08	22.6
Physical Science & Engineering	46.36	49.56
Social Sciences	21.12	19.59
Humanities & the Arts	7.44	8.24

Measures

Psychosocial factors: 5 indexes

- Autonomy, competence, relatedness, disciplinary knowledge, recognition

Sociodemographic characteristics:

- Institutional data: sex, URM status, international student status, first-generation college student status, and discipline
- Survey questions: gender identity, family income

Anticipatory socialization experiences:

- Categorical variable that identifies none, one or two, and more than two anticipatory socialization experiences (5 experiences considered such as published work or participated in a formal undergraduate research program)

Intermediary socialization outcomes:

- Disciplinary identity development (scale 1-8)
- Frequency of intention to quit (scale 1-5)

Analytical Approach

RQ 1: Group-based trajectory modeling (GBTM; Nagin, 2005)

RQ 2: Contingency analysis and multinomial logit model

RQ 3: Kruskal Wallis test, rank-based nonparametric test

Results



Figure 2.
Developmental trajectory
groups according to five
psychosocial
characteristics

Note: The order indicates
whether the trajectory was
flat (0), linear (1), or
quadratic (2). The dash lines
represent a 95% confident
interval.

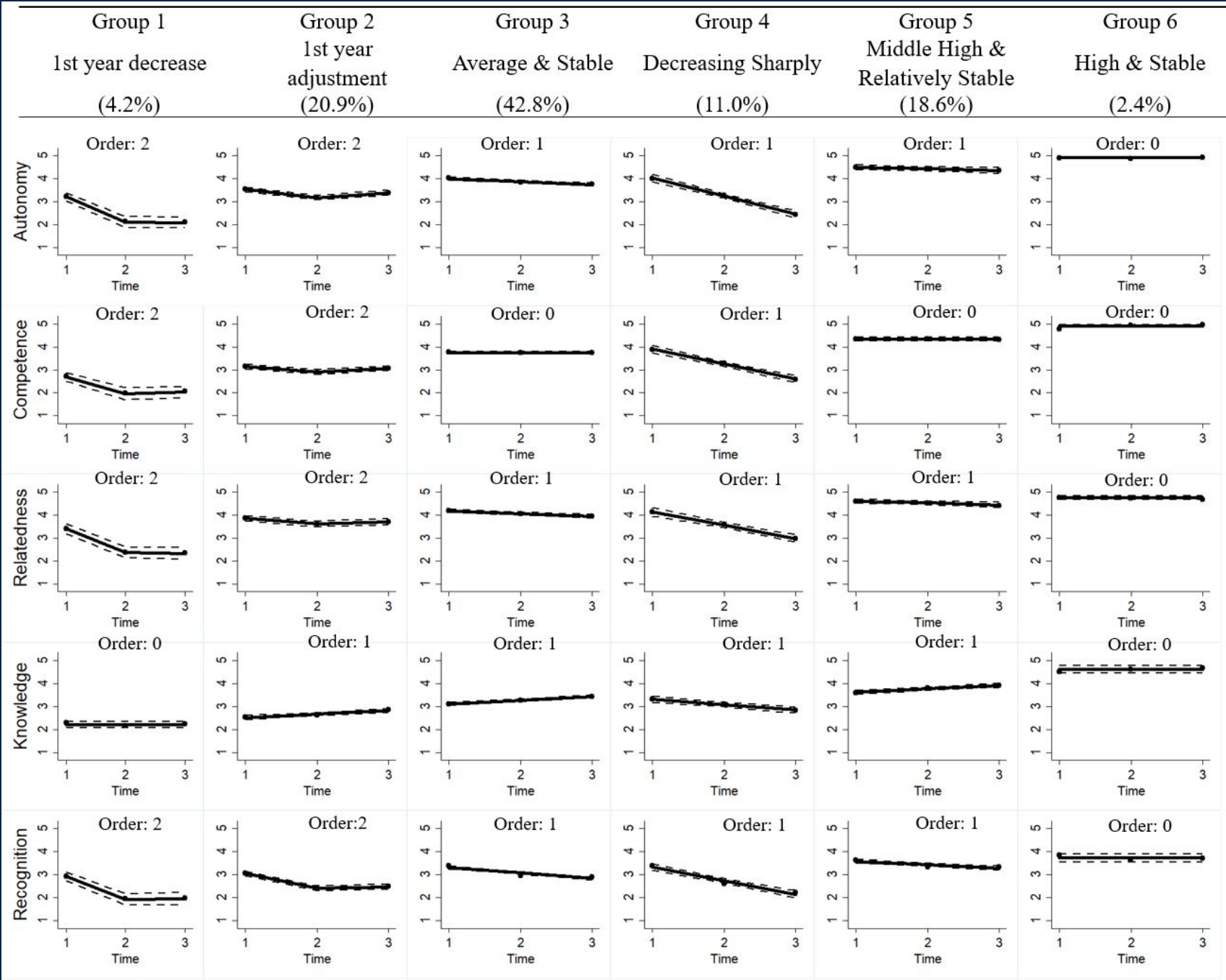


Table 4 Predicted probabilities of belonging to each trajectory group by sex and academic field.

Sex	Academic field	G1: 1st year decrease	G2: 1st year adjustment	G3: Average & Stable	G4: Decreasing Sharply	G5: Middle High & Relatively Stable
		(4.19%)	(21.60%)	(44.62%)	(9.97%)	(17.25%)
Female	Bio. & Health Sci.	0.015	0.194	0.520	0.114	0.157
Female	Phys. Sci. & Engin.	0.076	0.249	0.439	0.097	0.139
Female	Social Sciences	0.031	0.272	0.418	0.092	0.187
Female	Humanities	0.069	0.216	0.451	0.091	0.173
Male	Bio. & Health Sci.	0.052	0.172	0.474	0.072	0.23
Male	Phys. Sci. & Engin.	0.029	0.209	0.480	0.097	0.184
Male	Social Sciences	0.031	0.276	0.478	0.088	0.127
Male	Humanities	0.039	0.075	0.331	0.216	0.339

Note: Based on model presented in Table 4. In parentheses the proportion of students classified in each group. Covariates set at sample means. N=1223. Group 6 was excluded because of small sample size.

Table 5 Predicted probabilities of belonging to each trajectory group by family income

Family income	G1: 1st year decrease	G2: 1st year adjustment	G3: Average & Stable	G4: Decreasing Sharply	G5: Middle High & Relatively Stable
	(4.19%)	(21.60%)	(44.62%)	(9.97%)	(17.25%)
Low	0.054	0.200	0.334	0.218	0.194
Medium-Low	0.040	0.232	0.426	0.121	0.181
Medium-High	0.035	0.220	0.500	0.073	0.172
High	0.060	0.161	0.464	0.189	0.125

Note: Based on model presented in Table 4. In parentheses the proportion of students classified in each group. Covariates set at sample means. N=1223. Group 6 was excluded because of small sample size.

Table 6 Predicted probabilities of belonging to each trajectory group by anticipatory socialization experiences

Anticipatory socialization experiences	G1: 1st year decrease	G2: 1st year adjustment	G3: Average & Stable	G4: Decreasing Sharply	G5: Middle High & Relatively Stable
	(4.19%)	(21.60%)	(44.62%)	(9.97%)	(17.25%)
No experiences	0.063	0.273	0.443	0.084	0.138
1-2 experiences	0.043	0.237	0.488	0.085	0.147
More than 2	0.026	0.170	0.436	0.128	0.241

Note: Based on model presented in Table 4. In parentheses the proportion of students classified in each group. Covariates set at sample means. N=1223. Group 6 was excluded because of small sample size.

Table 3 Percentage of students by sociodemographic and anticipatory socialization characteristics and trajectory group

	Developmental Trajectory Groups					G6 High & Stable (2.37%)	Total n=1264	Chi2 (df)
	G1	G2	G3	G4	G5			
	1st year decrease (4.19%)	1st year adjustment (21.60%)	Average & Stable (44.62%)	Decreasing Sharply (9.97%)	Middle High & Relatively Stable (17.25%)			
Sociodemographic characteristics:								
Sex:								14.49** (5)
Male	41.51 ^a	43.22 ^a	48.4 ^a	46.03 ^a	51.38 ^a	76.67^b	47.94	
Female	58.49 ^a	56.78 ^a	51.6 ^a	53.97 ^a	48.62 ^a	23.33 ^a	52.06	
Gender								15.91* (10)
Gender queer/non-binary	1.96	2.94	1.25	2.38	2.29	0.00	1.91	
Man	43.14 ^a	43.01 ^a	48.21 ^a	45.24 ^a	50.46 ^a	75.86 ^b	47.61	
Woman	54.9 ^a	54.04 ^{ab}	50.54 ^{ab}	52.38 ^{ab}	47.25 ^{ab}	24.14 ^{ac}	50.48	
URM status:								11.93 (10)
Domestic non-URM	52.83	60.07	53.72	58.73	48.62	43.33	54.43	
URM	16.98	13.92	13.3	14.29	18.35	20.00	14.72	
International	30.19	26.01	32.98	26.98	33.03	36.67	30.85	
First generation college student	15.09	16.18	19.61	22.22	22.48	16.67	19.37	4.56 (5)
Family income background:								28.93** (15)
Low	3.92	2.94	2.68	7.14	4.59	3.45	3.58	
Low-Middle	33.33	33.46	32.32	40.48	37.61	24.14	34.16	
Middle-High	50.98 ^{ab}	56.99 ^a	57.68 ^a	38.89 ^b	53.21 ^a	58.62 ^{ab}	54.62	
High	11.76 ^{ab}	6.62 ^{ab}	7.32 ^a	13.49 ^b	4.59 ^a	13.79 ^{ab}	7.64	
Academic Field:								15.57 (15)
Biological & Health Sciences	16.98	21.61	27.13	25.4	26.61	20.00	25.08	
Physical Science & Engineering	50.94	45.79	46.45	46.03	44.5	56.67	46.36	
Social Sciences	20.75	26.37	19.86	19.84	20.18	10.00	21.12	
Humanities & the Arts	11.32	6.23	6.56	8.73	8.72	13.33	7.44	
Anticipatory socialization experiences:								
Work published	32.61 ^{ab}	37.94 ^a	46.04 ^b	50.00 ^{ab}	51.22 ^b	52.17 ^{ab}	45.2	13.04** (5)
Membership to a disciplinary organization	41.3 ^{abcd}	40.94 ^a	49.25 ^{ab}	56.2 ^{cb}	60.49 ^{dc}	56.52 ^{abcd}	49.96	21.11*** (5)
Service in disciplinary organization	19.57	22.44	23.96	33.61	30.69	43.48	25.98	13.36** (5)
Undergrad research experience	39.13	42.75	41.73	47.11	46.6	54.17	43.5	3.65 (5)
Master related to doctoral education	36.96 ^{ab}	33.86 ^a	36.95 ^a	36.61 ^{ab}	48.98 ^b	61.9 ^{ab}	38.75	16.90*** (5)
Anticipatory socialization experiences categories:								34.10*** (10)
No experience	26.42	21.61	16.67	14.29	13.3	23.33	17.48	
1-2 experiences	52.83 ^{ab}	52.38 ^{ab}	52.3 ^a	44.44 ^{ab}	41.74 ^b	36.67 ^{ab}	49.37	
More than 2 experiences	20.75 ^a	26.01 ^{ab}	31.03 ^{ac}	41.27 ^{abcd}	44.95 ^d	40.00^{abcd}	33.15	

Note: ***p<0.01, **p<0.05, *p<0.10. n=1264. In parentheses the proportion of students classified in each group. Percentages that share the same superscript letter indicate no statistical difference at p<.05, percentages with different superscript letters indicate a statistical difference at p<.05 using the Student-Newman-Keuls method.

Table 7 Mean of perceptions of disciplinary identity and intention to quit in T3 by trajectory group

	Developmental Trajectory Groups						Total	n	Kruskal-Wallis test
	G1: 1st year decrease	G2: 1st year adjustment	G3: Average & Stable	G4: Decreasing Sharply	G5: Middle High & Relatively Stable	G6: High & Stable			
Disciplinary Identity	3.24 ^a	3.84 ^a	4.50 ^b	3.82 ^a	4.94 ^c	5.81 ^c	4.36	1054	H(5)=119.718***
Quit frequency	2.88 ^a	2.15 ^b	1.76 ^c	2.86 ^a	1.42 ^d	1.26 ^d	1.92	1048	H(5)=156.037***

Note: Disciplinary identity was measured with the following question “In thinking about your development as a scholar or researcher in your discipline, where would you currently place yourself in the following continuum?” (1-Student (Knowledge Consumer) to 8-Scholar or Researcher (Knowledge Producer)).

Quit frequency was measured with the following question “Looking back over the past academic year, approximately how often did you think about permanently quitting doctoral study?” (1-Never, 2-A couple of times over the year, 3-A couple of times a month, 4-A couple of times a week, 5-Every day). In parentheses the proportion of students classified in each group. ***p<0.01, **p<0.05. Means that share the same superscript letter indicate no statistical difference at p<.05, means with different superscript letters indicate a statistical difference at p<.05 using Dunn tests and sidak method.

A group of five people are seated around a dark conference table in a meeting room. The room is dimly lit, with a coffee station visible in the background. The people are engaged in conversation. A woman in the center has a name tag that reads "Elyse Aurbach".

Conclusions

Conclusions

- Heterogeneity in the developmental trajectories of doctoral students based on their perceptions of 5 psychosocial characteristics
- Developmental trajectories vary according to demographic and predoctoral experiences
- Developmental groups are associated with intermediary socialization outcomes

Thank You

Please let us know if you have any questions.

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Implications

Understanding psychosocial traits and anticipatory experiences for doctoral student populations as they begin their studies can be a powerful tool to enhance the student experience and tailor programs and interventions

Focusing on factors that might shape the development of scholars and researcher identities might both help enhance the experience of students and help support and develop nascent researchers across a variety of areas thus contributing to a more equitable landscape of graduate education

Table 3 Percentage of students by sociodemographic and anticipatory socialization characteristics and trajectory group

	Developmental Trajectory Groups						Total	Chi2
	G1	G2	G3	G4	G5	G6	n=1264	(df)
	1st year decrease	1st year adjustment	Average & Stable	Decreasing Sharply	Middle High & Relatively Stable	High & Stable		
	(4.19%)	(21.60%)	(44.62%)	(9.97%)	(17.25%)	(2.37%)		
Sociodemographic characteristics:								
Sex:								14.49** (5)
Male	41.51 ^a	43.22 ^a	48.4 ^a	46.03 ^a	51.38 ^a	76.67 ^b	47.94	
Female	58.49 ^a	56.78 ^a	51.6 ^a	53.97 ^a	48.62 ^a	23.33 ^a	52.06	
Gender								15.91* (10)
Gender queer/non-binary	1.96	2.94	1.25	2.38	2.29	0.00	1.91	
Man	43.14 ^a	43.01 ^a	48.21 ^a	45.24 ^a	50.46 ^a	75.86 ^b	47.61	
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First generation college student	15.09	16.18	19.61	22.22	22.48	16.67	19.37	4.56 (5)
Family income background:								
								28.93** (15)
Low	3.92	2.94	2.68	7.14	4.59	3.45	3.58	
Low-Middle	33.33	33.46	32.32	40.48	37.61	24.14	34.16	
Middle-High	50.98 ^{ab}	56.99 ^a	57.68 ^a	38.89 ^b	53.21 ^a	58.62 ^{ab}	54.62	
High	11.76 ^{ab}	6.62 ^{ab}	7.32 ^a	13.49 ^b	4.59 ^a	13.79 ^{ab}	7.64	
Academic Field:								15.57 (15)
Biological & Health Sciences	16.98	21.61	27.13	25.4	26.61	20.00	25.08	
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Service in disciplinary organization	19.57	22.44	23.96	33.61	30.69	43.48	25.98	13.36** (5)
Undergrad research experience	39.13	42.75	41.73	47.11	46.6	54.17	43.5	3.65 (5)
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Anticipatory socialization experiences categories:								34.10*** (10)
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Note: ***p<0.01, **p<0.05, *p<0.10. n=1264. In parentheses the proportion of students classified in each group. Percentages that share the same superscript letter indicate no statistical difference at p<.05, percentages with different superscript letters indicate a statistical difference at p<.05 using the Student-Newman-Keuls method.