

Integrative Perspectives of Academic Motivation

Jessica Rebecca Chittum

Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in
partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Curriculum and Instruction
with a specialization in Educational Psychology

Brett D. Jones, Committee Chair
Peter E. Doolittle
Kathryne D. McConnell
Jesse L. Wilkins

February 10, 2015
Blacksburg, VA

Keywords: academic motivation, autonomy, cluster analysis, person-centered research, science
education

Integrative Perspectives of Academic Motivation

Jessica Rebecca Chittum

ABSTRACT

My overall objective in this dissertation was to develop more integrative perspectives of several aspects of academic motivation. Rarely have researchers and theorists examined a more comprehensive model of academic motivation that pools multiple constructs that interact in a complex and dynamic fashion (Kaplan, Katz, & Flum, 2012; Turner, Christensen, Kackar-Cam, Trucano, & Fulmer, 2014). The more common trend in motivation research and theory has been to identify and explain only a few motivation constructs and their linear relationships rather than examine complex relationships involving “continuously emerging systems of dynamically interrelated components” (Kaplan et al., 2014, para. 4). In this dissertation, my co-author and I focused on a more integrative perspective of academic motivation by first reviewing varying characterizations of one motivation construct (Manuscript 1) and then empirically testing dynamic interactions among multiple motivation constructs using a person-centered methodological approach (Manuscript 2). Within the first manuscript (Chapter 2), a theoretical review paper, we summarized multiple perspectives of the need for autonomy and similar constructs in academic motivation, primarily autonomy in self-determination theory, autonomy supports, and choice. We provided an integrative review and extrapolated practical teaching implications. We concluded with recommendations for researchers and instructors, including a call for more integrated perspectives of academic motivation and autonomy that focus on complex and dynamic patterns in individuals’ motivational beliefs. Within the second manuscript (Chapter 3), we empirically investigated students’ motivation in science class as a complex, dynamic, and context-bound phenomenon that incorporates multiple motivation constructs. Following a person-centered approach, we completed cluster analyses of students’ perceptions of 5 well-known motivation constructs (autonomy, utility value, expectancy, interest, and caring) in science class to determine whether or not the students grouped into meaningful “motivation profiles.” 5 stable profiles emerged: (1) low motivation; (2) low value and high support; (3) somewhat high motivation; (4) somewhat high empowerment and values, and high support; and (5) high motivation. As this study serves as a proof of concept, we concluded by describing the 5 clusters. Together, these studies represent a focus on more integrative and person-centered approaches to studying and understanding academic motivation.

Table of Contents

Table of Contents	iii
Attribution	vi
Acknowledgements	vii
List of Tables	ix
List of Figures	x
Chapter 1: Introduction	1
Theoretical Underpinnings	1
Rationale	3
Research Methods and Questions	7
References	10
Chapter 2: The Role of Autonomy in Academic Motivation: Conceptualizing Varying Perspectives, Theories, and Evidence (Manuscript 1)	16
Abstract	16
Introduction	17
Definitions of Autonomy and Related Constructs	18
Self-Determination Theory and Autonomy	22
Internalization, Autonomous Motivation, and Intrinsic Motivation	24
The Role of Autonomy in Self-Determination Theory	27
The Significance of Autonomy in Self-Determination Theory	30
Practical Educational Implications	31
Autonomy and Values	31
Functional Significance	33
Extrinsic Rewards	34
Autonomy and Competence	35
Autonomy Support	36
Conditions of Autonomy Support	39
Nurture Inner Motivational Resources	40
Communicate Value and Provide Rationales	41
Acknowledge and Accept Expressions of Negative Affect and Individual Perspectives	42
Use Informational, Noncontrolling Language	42
Offer/Convey Choice	43
Autonomy Supportive Teacher Behaviors	44
Evidence for Autonomy Support	46
Choice	50
Negative Conceptions of Choice	53
Redefining Choice Within the Self-Determination Framework	55
Practical Educational Implications	56
Competence and Choice	57
Action Choice	58
Recommendations and Future Directions	61
References	63
Chapter 3: Identifying Motivation Profiles of Students in Science Class	77
Abstract	77

Introduction	78
Constructs Selected for the Person-Centered Analysis.....	80
Conceptual Framework	82
Class Perceptions	83
Empowerment.....	83
Usefulness	85
Success	85
Interest.....	86
Caring.....	88
Summary	89
Motivational Beliefs.....	89
Research Questions	90
Methodology	91
Participants.....	91
Procedures.....	92
Measures	92
Class Perceptions	93
Motivational Beliefs.....	94
Outcomes	95
Analysis.....	95
Results.....	99
Cluster Analyses	101
Stage 1: Clusters Per Year	102
Initial Cluster Typology	105
Discriminant Analysis.....	106
Final Cluster Typology	109
Stage 2: Stability Tests.....	109
Grade Level and Sex Associations	114
Predictive Validity	115
Science Interest Value.....	115
Science Attainment Value.....	115
Science Utility Value	115
Science Competence Beliefs.....	116
Science Class Effort.....	116
Science Class Grade Estimate.....	116
Discussion.....	117
Profile Descriptions	118
Cluster 1: Low Motivation Profile.....	118
Cluster 2: Low Value and High Support Profile.....	118
Cluster 3: Somewhat High Motivation Profile	119
Cluster 4: Somewhat High Empowerment and Values, and High Support Profile.....	120
Cluster 5: High Motivation Profile	120
Trends Across Profiles.....	121
Sex Differences.....	123
Context-Dependent Motivation	123

Future Research and Limitations	124
References.....	126
Appendix.....	145
Chapter 4: Conclusions and Future Directions	148
Introduction.....	148
Manuscript 1: The Role of Autonomy in Academic Motivation: Conceptualizing Varying Perspectives, Theories, and Evidence.....	149
Manuscript 2: Identifying Motivation Profiles of Students in Science Class	150
Connecting the Manuscripts	152
Theoretical Implications	153
Key Points.....	156
Future Research	156
References.....	158

Attribution

Dr. Brett D. Jones is named as second author of Manuscript 1 and Manuscript 2. He contributed intellectually to the development of both manuscripts.

Acknowledgements

The material presented in this paper is based upon work supported by the National Science Foundation (NSF) under Grant No. DRL 1029756. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of NSF.

A dissertation is not something one does alone. Without the support of many others, this process would have been much more unpleasant, if not impossible. While you may not have written these words, I did not traverse this process alone.

First, many thanks to my advisor, Brett Jones. Thank you for the hours of meetings and your patience with me as I navigated this dissertation. You guided me through my doctoral program and dissertation alike, and your feedback and mentorship have been instrumental in my success. I'm especially thankful that you inspired me to pursue educational psychology while I was an undergraduate student in Florida. It was those many years ago that you introduced me to academic motivation and—just like that—I was hooked.

I have had many other wonderful mentors at Virginia Tech. Thanks go to Peter Doolittle for not only serving on my committee but, more importantly, for inviting me to join CIDER as a graduate assistant in 2011 when I became a “CIDER-ite” for three outstanding years. Many thanks for the innumerable impromptu chats, sage advice, and for encouraging me, my ideas, and my goals as a graduate student, graduate assistant, and scholar. Special thanks also go to Peter for making it possible for me to work with someone as lovely as Bonnie Alberts. I don't know how many hours she and I chatted over the years but I can say with certainty that I always walked away happier and encouraged. Similar sentiments go to the other CIDER-ites I had the pleasure to work with and who also guided me to this point.

My remaining committee members also deserve many thanks. Kate McConnell has served as an excellent teacher, mentor, and research partner. Thank you for your support, your advice, and for joining me on this journey as a committee member. Jay Wilkins: thank you for agreeing to serve on my committee and for your excellent counsel and feedback.

I also want to thank Dr. Eric Vance of Virginia Tech's Laboratory for Interdisciplinary Statistical Analysis for meeting with me and talking through cluster analysis. His instruction and support were very important in the development of the second manuscript in this dissertation.

Finally, to my friends and family: I can't emphasize the importance of your unfailing support, even when you simply left me alone to work. Infinite thanks to my dad, the surefire support. Your unwavering encouragement and pride has had a tremendous impact. You taught me to look at the world as a scientist: questioning and examining. Without those skills you modeled and instilled in me, I would not have pursued the goals I have. Many thanks to my mom, who taught me three imperative life lessons: what it is to work hard, persevere, and make a difference. Michael, you more than most others were present and persevered alongside me. Thank you for joining me on this journey, being there to listen to my ramblings about clustering procedures and profiles, and for the times that you were content to fill up the silence when my mind was turning too much to explain. To my sisters and brother, thank you for putting up with me, listening when I needed listening to, and laughing when I needed laughs. And finally, untold thanks to my grandparents: I think of all of you and miss you everyday. You wonderful grand people were with me every step of the way, teaching me to work hard, be patient, and have confidence in myself.

I can't thank all of you enough.

List of Tables

Table 1: The Five Conditions of Autonomy Support and Example Sources.....	40
Table 2: Summary of Beneficial and Detrimental Practices in Providing Choice	60
Table 3: The MUSIC Model Components, Definitions, and Related Constructs.....	93
Table 4: Correlations and Descriptive Statistics, 2014.....	100
Table 5: Proximity Matrix of Agglomeration Schedule, 2012	103
Table 6: Five-Cluster Solution: Comparisons Among Years	104
Table 7: Discriminant Function Analysis, 2014	107
Table 8: Unstandardized Canonical Discriminant Functions at Cluster Centroid, 2014	109
Table 9: Five-Cluster Solution: Comparisons Among Grade Levels	110
Table 10: Five-Cluster Solution: Comparisons of Year, Grade Level, and All Combined	113

List of Figures

Figure 1: Summaries of Several Definitions of Autonomy and Related Constructs	21
Figure 2: The Process of Internalization.....	25
Figure 3: Autonomy Support Aligned With the MUSIC Model of Academic Motivation and Other Related Motivation Constructs	48
Figure 4: Conceptual Model	82
Figure 5: Cluster Centers for Each Year (2012-2014).....	105
Figure 6: Cluster Centers for Each Grade Level (Fifth, Sixth, Seventh).....	111
Figure 7: Cluster Centers for All Data.....	114
Figure 8: 2014 Cluster Comparisons Across Correlated Variables	117

Chapter 1: Introduction

Theoretical Underpinnings

Motivated students are more likely to be engaged, persist in their studies, and perform well, as well as demonstrate many other positive outcomes (Deci & Ryan, 2000; Hagger & Chatzisarantis, 2011; Reeve, 2005; Reeve & Lee, 2014; Reeve & Nix, 1997; Wigfield, & Eccles, 2000). Motivation literature endeavors to explain such behaviors as task choice, vigor in completing tasks, and task performance (Wigfield, & Eccles, 2000). In general, motivation involves processes that influence behavior by providing both energy and direction (Reeve, 2005, p. 6). “Academic motivation is not important in and of itself, but rather it is important because motivated students tend to engage in activities that help them to learn and achieve highly in academic settings” (Jones, 2009, p. 272). *Engagement* is the cognitive and emotional state whereby students’ behavioral involvement in tasks is sustained and they experience positive affect towards the task (Skinner & Belmont, 1993, p. 572), and involves task initiation, selection, effort, and concentration.

Jones (2009) developed a model of academic motivation comprised of five components of motivation that serves as an organizational framework for understanding research, theory, and practical strategies more comprehensively: eMpowerment, Usefulness, Success, Interest, and Caring (Jones, 2009). The second letter of empowerment and the first letter of the remaining four components create the acronym “MUSIC” and Jones (2009, p. 273) termed it the MUSIC Model of Academic Motivation. The main tenants of the model are that students are motivated when they believe they are *empowered* in class, that what they are doing in class is *useful*, they can be *successful* if they put forth effort, the class activities or topics are *interesting*, and that others *care*

for them and their successes (Jones, 2009). The MUSIC model was derived from an extensive review of motivation literature surrounding academic motivation and is a framework comprising motivating factors identified through scholarly research (Jones, 2009). Furthermore, the model was developed to assist teachers in understanding and applying theory and research in motivation to their instructional design and practices (Jones, 2009). The MUSIC model is the primary conceptual framework for academic motivation I utilize in this dissertation.

One well-researched principle in academic motivation is that empowering students (the “M” in the MUSIC model) by providing them with autonomy can increase their motivation. Deci and Ryan’s self-determination theory, one of the better-known theories of motivation, postulates that autonomy is one of three physiological needs necessary for optimal functioning (Deci & Ryan, 1985, 2000). The experience of autonomy involves being the cause of one’s actions, exerting some control over one’s behaviors and choices, and experiencing feelings of freedom and volition (deCharms, 1968; Deci & Ryan, 2000). Perceived autonomy is considered essential to high *quality* motivation, or more autonomous motivation (e.g., Deci & Ryan, 1985; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009), and those who are autonomously motivated often perform better, seek more challenges, are more persistent in tasks, and demonstrate more creativity (Deci, Vallerand, Pelletier, & Ryan, 1991; Deci & Ryan, 2000; Koestner, Ryan, Bernieri, & Holt, 1984). The need for autonomy has been considered more significant than other psychological needs; indeed, the theory’s namesake, “self-determination,” concerns acting according to one’s desires or personal endorsement, which is to behave autonomously and freely (Deci & Ryan, 2012). Overall, evidence suggests that understanding how to motivate students, particularly the provision of autonomy in the learning environment, is important for engaging students in learning.

Rationale

My primary objective in this dissertation was to investigate academic motivation from an integrative stance. I focused on this main purpose by (1) specifically examining autonomy, constructs closely related to autonomy, and teaching implications related to autonomy and motivation more generally; and (2) more broadly studying the dynamic interplay of five motivation constructs. Concerning the first, I primarily studied the concept of autonomy in academic motivation literature. In the second, I examined student motivation from the context of science class, specifically.

When concentrating on one aspect of the MUSIC model—empowerment (akin to the motivation construct *autonomy*)—I found that prior research findings are inconclusive with respect to tasks that elicit perceived autonomy and desire for autonomy. Research suggests that some events/tasks/issues incite a desire for autonomy and others do not (e.g., Botti, Orfali, & Iyengar, 2009; Daddis, 2011; Königs, Brand-Gruwel, & Elen, 2012). Further, this desire for autonomy often varies among individuals (e.g., Jalil, Sbeih, Boujettif, & Barakat, 2009; Lin, Liang, Su, & Tsai, 2013). Researchers do not understand how much autonomy is needed in particular contexts for academic motivation or the influences that play a significant role. Some have argued that individuals need or crave a lot of autonomy (e.g., Jalil et al., 2009) and others postulate that too much autonomy can be detrimental to positive functioning (Eccles et al., 1991; Isakson & Jarvis, 1999; Schwartz, 2000). The “amount” of autonomy that is needed (or is optimal) is unknown in many contexts (Deci & Ryan, 1987) although, in general, the self-determination theory perspective indicates that the need for autonomy is foremost to other sources of motivation and is necessary for obtaining higher quality motivation (Deci & Ryan, 1985; Vansteenkiste et al., 2009). Thus, research findings are equivocal.

In addition, several contextual and interpersonal characteristics have been identified and are posited to affect perceived autonomy in a variety of learning environments, and comprise an “autonomy-supportive” style (Reeve, 2006; Reeve, Jang, Carrell, Jeon, & Barch, 2004; Su & Reeve, 2011). The concept of *autonomy support* involves interpersonal behaviors that directly nurture autonomous functioning in others and includes five autonomy-supportive conditions (Reeve, 2006). However, when these conditions are interpreted from the context of other perspectives (e.g., the MUSIC model) some appear to address motivation constructs other than the need for autonomy. For example, one condition involves supporting students’ ability perceptions (Su & Reeve, 2011), which aligns with the *success* component in the MUSIC model—considered a distinct yet correlated construct from empowerment (Jones & Wilkins, 2013)—as well as other constructs like self-efficacy (Bandura, 1986) and expectancy for success (Wigfield & Eccles, 2000). In addition, providing rationales for why something is important (Su & Reeve, 2011), another condition of autonomy support, is consistent with the *usefulness* component of the MUSIC model and the concept of utility-value in expectancy-value theory (Wigfield & Eccles, 2000). Previous research further submits that the conditions of autonomy support are interactive; interpersonal behaviors are most effective in supporting autonomy when not isolated to only nurturing perceived autonomy, which implies the importance of multiple motivation-related constructs (Deci, Eghrari, Patrick, & Leone, 1994; Reeve, Nix, & Hamm, 2003; Su & Reeve, 2011). Because of these equivocal perspectives, I sought to better understand the concept of autonomy as a motivation construct by examining the nuances of several key perspectives, and analyzing these perspectives to extract practical implications for instructors.

My second focus was to study the dynamic interactions among all five MUSIC model constructs within the context of science class. Researchers and theorists have rarely examined a

more comprehensive model of academic motivation that pools multiple constructs that interact in a complex and dynamic fashion (Kaplan, Katz, & Flum, 2012, 2014; Turner, Christensen, Kackar-Cam, Trucano, & Fulmer, 2014; Turner & Meyer, 2000). The trend in motivation research and theory to identify and explain only a few motivation constructs has been critiqued as “incompatible with emergent understandings of motivational phenomena as continuously emerging systems of dynamically interrelated components” (Kaplan et al., 2014, para. 4).

Although some existing theories include multiple components of motivation (e.g., self-determination theory cites autonomy, competence, and relatedness; Deci & Ryan, 2000), such perspectives have not fused the five components of the MUSIC model. A broader view that takes into consideration multiple components of motivation that interact with one another per individual and within multifaceted learning environments is wanting (Kaplan et al., 2012).

Related to the notion of a more integrative view of motivation is what has been termed a *person-centered* or *person* approach to research (Bergman, 2001). Person-centered research focuses on the complex nature of the individual, which common research tactics often ignore in place of investigating the effects of isolated variables, linearly (Bergman, 2001; Kaplan et al., 2012). In a person-centered approach, motivation constructs are studied as dynamic, interactionistic processes, emphasizing a holistic view of the individual as central, rather than the variable (Bergman, 2001).

When investigating a more integrative, dynamic perspective of motivation, I focused on academic motivation specifically from the context of science class. Although it is important to examine motivation in many contexts (e.g., academics in general, other fields), this dissertation serves as a starting point; hence, I focused on only the domain of science. I selected the context of science for this study for several reasons. Finding well-educated and trained professionals to

fill science, technology, engineering, and mathematics (STEM) positions is a national concern. A recent *Forbes* article cited engineering as the most difficult job to fill in the US (Smith, 2012) and the National Academy of Sciences (NAS, 2007) argued that research and funding in STEM fields is integral to US prosperity. Some have posited that student success in mathematics and science is central to meeting those needs (NAS, 2007; President's Council of Advisors on Science and Technology [PCAST], 2012; Smith, 2012). Therefore, continued focus on STEM education by refining current educational practices, curriculum, and standards is vital to the continued prosperity of the US, as well as to remaining a competitive world leader in growth and research (NAS, 2007). Not only have reports indicated that students are increasingly entering higher education underprepared for and uninterested in pursuing STEM fields (Osborne, 2003; PCAST, 2012), targeting students early in their educational careers is vital, particularly in terms of positively affecting their science goals (PCAST, 2010; Maltese & Tai, 2010; Tai, Liu, Maltese, & Fan, 2006). Nurturing students' motivation and interest in science prior to eighth grade is important for long-term persistence (Maltese & Tai, 2010; Tai et al., 2006) and that "closing this gap will require coordinated action on many fronts starting in the earliest grades" (PCAST, 2012, p. 6).

Although interest in science tends to wane with age (Osborne, 2003; Simpson & Oliver, 1990), teaching methods and school culture can positively affect science persistence and motivation, which often declines in less supportive environments (Fortus & Vedder-Weiss, 2014; Vedder-Weiss & Fortus, 2010). Also emphasized is the need for recruiting, retaining, and educating teachers who will play a critical role in this endeavor, particularly teachers in the early grades, such as at the elementary and middle levels (PCAST, 2010, 2012). To target students for STEM fields early in their educational careers, continued research is needed and, "in particular, a

better understanding of what actions can be taken to excite children about science, mathematics, and technology . . . [when] designing future educational programs” (NAS, 2007, p. 115).

According to the Concise Oxford English Dictionary (2011), *excite* is to: (1) “cause strong feelings of enthusiasm and eagerness in (someone),” (2) “bring out or give rise to (a feeling or reaction),” and (3) “produce a state of increased energy or activity in (a physical or biological system)” (p. 497). Consequently, exciting children about STEM fields suggests an intentional focus on designing K-12 science instruction to motivate, inspire, and engage (PCAST, 2010). To meet this need for improved science education, a sustained focus on motivation is important for engaging and retaining students in science fields early in their educational careers as well as for producing not only scientists, but effective, creative, and well-prepared professionals.

Research Methods and Questions

The goals of this dissertation are to (1) summarize how multiple perspectives have characterized the role of autonomy in academic motivation, including practical implications for instructors; and (2) to empirically investigate students’ motivation in class as a complex, dynamic, and context-bound phenomenon that incorporates multiple motivation constructs and perspectives. This dissertation follows the manuscript design: I completed one theoretical/review manuscript (Chapter 2), one empirical study (Chapter 3), and I provide overarching conclusions in the final chapter (Chapter 4). My objective was to approach motivation from an integrative viewpoint: in the first manuscript I sought to accomplish this by examining autonomy-related constructs and the many teaching strategies that have been proposed to foster autonomy, and in the second manuscript by investigating the dynamic interactions of multiple motivation constructs from the context science class. Both manuscripts are written using first-person plural

pronouns, as they will be submitted for review as co-authored papers (first author: Jessica R. Chittum; second author: Brett D. Jones).

Manuscript 1, titled “The Role of Autonomy in Academic Motivation: Conceptualizing Varying Perspectives, Theories, and Evidence,” is a literature review of the role of autonomy in academic motivation that covers several theoretical perspectives. The three main perspectives reviewed are self-determination theory, autonomy support, and choice. We conclude by positing that multiple motivation constructs can work together to support student motivation and engagement, and make recommendations for researchers and practitioners that align with this stance. As few integrated reviews exist that closely examine multiple perspectives of autonomy in academic motivation, this paper will contribute to the literature through an in-depth investigation of the relationships among current theories and research, evident gaps, teaching implications, and areas for future study.

Manuscript 2, titled “Identifying Motivation Profiles of Students in Science Class,” is a quantitative study of the complex nature of multiple motivation components that can affect the varying perceptions students have for science class. Similar to Manuscript 1, this research considers multiple perspectives of academic motivation. Our research questions were: (1) Can students’ science class perceptions be used to categorize students into groups with similar motivation profiles? (2) If different student motivation profiles can be identified, do the profiles relate to other important motivational beliefs and academic outcomes? The sample included a total of 937 completed self-report questionnaires of Likert-type items assessing students’ perceptions of the MUSIC components in science class and several motivational beliefs (e.g., science class effort, science utility value). Following a person-centered approach, we completed cluster analyses of students’ perceptions of empowerment, usefulness, success, interest, and

caring in science class to determine if the students grouped into meaningful “motivation profiles.” Then, we validated the profiles by examining relationships with several correlated and outcome variables, described each profile, and concluded with by listing several directions for future research. The findings of this investigation may help educators target students with similar motivation profiles rather than adhere to the difficult and often unrealistic task of catering to each student’s complex needs individually.

References

- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Bergman, L. R. (2001). A person approach in research on adolescence: Some methodological challenges. *Journal of Adolescent Research*, 16, 28-53. doi:10.1177/0743558401161004
- Botti, S., Orfali, K., & Iyengar, S. S. (2009). Tragic choices: Autonomy and emotional responses to medical decisions. *Journal of Consumer Research*. 36(3), 337-352.
doi:10.1086/598969
- Concise Oxford English dictionary* (Luxury ed.). (2011). New York, NY: Oxford University Press.
- Daddis, C. (2011). Desire for increased autonomy and adolescents' perceptions of peer autonomy: "Everyone else can; why can't I?" *Child Development*, 82(4), 1310-1326.
doi:10.1111/j.1467-8624.2011.01587.x
- deCharms, R. (1968). *Personal causation: The internal affective determinants of behavior*. New York, NY: Academic Press.
- Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality*, 62(1), 119-142.
doi:10.1111/j.1467-6494.1994.tb00797.x
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum Press.
- Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology*, 53(6), 1024-1037. doi:10.1037/0022-3514.53.6.1024

Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227-268.
doi:10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (2012). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 85-107). New York, NY: Oxford University Press.

Deci, E. L., Vallerand, R. J., Pelletier, L. C., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist*, 26(3/4), 325-346.
doi:10.1080/00461520.1991.9653137

Eccles, J. S., Buchanan, C. M., Flanagan, C., Fuligni, A., Midgley, C., & Yee, D. (1991). Control versus autonomy during early adolescence. *Journal of Social Issues*, 47(4), 53-68.
doi:10.1111/j.1540-4560.1991.tb01834.x

Fortus, D., & Vedder-Weiss, D. (2014). Measuring students’ continuing motivation for science learning. *Journal of Research in Science Teaching*, 51(4), 497-522.
doi:10.1002/tea.21136

Hagger, M. S., & Chatzisarantis, N. L. D. (2011). Causality orientations moderate the undermining effect of rewards on intrinsic motivation. *Journal of Experimental Social Psychology*, 47, 485-489. doi:10.1016/j.jesp.2010.10.010

Isakson, K., & Jarvis, P. (1999). The adjustment of adolescents during the transition into high school: A short-term longitudinal study. *Journal of Youth and Adolescence*, 28(1), 1-26.

Jalil, P. A., Sbeih, M. Z. A., Boujettif, M., & Barakat, R. (2009). Autonomy in science education: A practical approach in attitude shifting towards science learning. *Journal of Science Education and Technology*, 18(6), 476-486. doi:10.1007/s10956-009-9164-4

- Jones, B. D. (2009). Motivating students to engage in learning: The MUSIC model of academic motivation. *International Journal of Teaching and Learning in Higher Education*, 21(2), 272-285. Retrieved from <http://www.isetl.org/ijtlhe/pdf/IJTLHE774.pdf>
- Jones, B. D., & Wilkins, J. L. M. (2013). Testing the MUSIC Model of Academic Motivation through confirmatory factor analysis. *Educational Psychology*, 33(4), 482-503. doi:10.1080/01443410.2013.785044
- Kaplan, A., Katz, I., & Flum, H. (2012). Motivation theory in educational practice: Knowledge claims, challenges, and future directions. In K. R. Harris, S. G. Graham, & T. Urdan (Eds.), *APA educational psychology handbook: Individual differences, cultural considerations, and contextual factors in educational psychology* (Vol. 2, pp. 165-194). Washington, DC: American Psychological Association.
- Kaplan, A., Katz, I., & Flum, H. (2014, April). Practice-relevant motivational research: Do we need a different approach? In L. Corno (Chair), *Practice-relevant motivational research: Do we need a different approach?* Symposium conducted at the annual meeting of the American Educational Research Association, Philadelphia, PA.
- Koestner, R., Ryan, R. M., Bernieri, F., & Holt, K. (1984). Setting limits in children's behavior: The differential effects of controlling vs. informational styles on intrinsic motivation and creativity. *Journal of Personality*, 52(3), 233-248. doi:10.1111/j.1467-6494.1984.tb00879.x
- Könings, K. D., Brand-Gruwel, S., & Elen, J. (2012). Effects of a school reform on longitudinal stability of students' preferences with regard to education. *British Journal of Educational Psychology*, 82, 512-532. doi:10.1111/j.2044-8279.2011.02044.x

- Lin, C.-L., Liang, J.-C., Su, Y.-C., & Tsai, C.-C. (2013). Exploring the relationships between self-efficacy and preference for teacher authority among computer science majors. *Journal of Educational Computing Research*, 49(2), 189-207. doi:10.2190/EC.49.2.d
- Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the fridge: Sources of early interest in science. *International Journal of Science Education*, 32, 669-685. doi:10.1080/09500690902792385
- National Academy of Sciences (NAS). (2007). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Washington, DC: National Academies Press. Retrieved from <http://www.sandia.gov/NINE/documents/RisingAbove.pdf>
- Osborne, J. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, 25(9), 1049-1079. doi:10.1080/0950069032000032199
- President's Council of Advisors on Science and Technology (PCAST). (2010). *Report to the President: Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America's future*. Retrieved from <http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf>
- President's Council of Advisors on Science and Technology (PCAST). (2012). *Report to the president: Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics*. Retrieved from http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-executive-report-final_2-13-12.pdf
- Reeve, J. (2005). *Understanding motivation and emotion*. Hoboken, NJ: Wiley.

- Reeve, J. (2006). Teachers as facilitators: What autonomy-supportive teachers do and why their students benefit. *Elementary School Journal*, 106(3), 225-236. doi:10.1086/501484
- Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and Emotion*, 28(2), 147-169. doi:10.1023/B:MOEM.0000032312.95499.6f
- Reeve, J., & Lee, W. (2014). Students' classroom engagement produces longitudinal changes in classroom motivation. *Journal of Educational Psychology*, 106(2), 527-540. doi:10.1037/a0034934
- Reeve, J., & Nix, G. (1997). Expressing intrinsic motivation through acts of exploration and facial displays of interest. *Motivation and Emotion*, 21(3), 237-250. doi:10.1023/A:1024470213500
- Reeve, J., Nix, G., & Hamm, D. (2003). Testing models of the experience of self-determination in intrinsic motivation and the conundrum of choice. *Journal of Educational Psychology*, 95(2), 375-392. doi:10.1037/0022-0663.95.2.375
- Schwartz, B. (2000). Self-determination: The tyranny of freedom. *American Psychologist*, 55(1), 79-88. doi:10.1037//0003-066X.55.1.79
- Simpson, R. D., & Oliver, J. S. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. *Science Education*, 74(1), 1-18. doi:10.1002/sce.3730740102
- Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology*, 85(4), 571-581. doi:10.1037/0022-0663.85.4.571

- Smith, J. (2012, May 29). The 10 hardest jobs to fill in America. *Forbes*. Retrieved from <http://www.forbes.com/sites/jacquelynsmith/2012/05/29/the-10-hardest-jobs-to-fill-in-america-2/>
- Su, Y.-L., & Reeve, J. (2011). A meta-analysis of the effectiveness of intervention programs designed to support autonomy. *Educational Psychology Review*, 23(1), 159-188. doi:10.1007/s10648-010-9142-7
- Tai, R., Liu, C. Q., Maltese, A. V., & Fan, X. T. (2006). Planning for early careers in science. *Science*, 312(5777), 1143-1144.
- Turner, J. C., Christensen, A., Kackar-Cam, H. Z., Trucano, M., & Fulmer, S. M. (2014). Enhancing students' engagement: Report of a 3-year intervention with middle school teachers. *American Educational Research Journal*, 51(6), 1195-1226. doi:10.3102/0002831214532515
- Turner, J. C., & Meyer, D. K. (2000). Studying and understanding the instructional contexts of classrooms: Using our past to forge our future. *Educational Psychologist*, 35(2), 69-85. doi:10.1207/S15326985EP3502_2
- Vansteenkiste, M., Sierens, El., Soenens, B., Luyckx, K., & Lens, W. (2009). Motivational profiles from a self-determination perspective: The quality of motivation matters. *Journal of Educational Psychology*, 101(3), 671-688. doi:10.1037/a0015083
- Vedder-Weiss, D., & Fortus, D. (2010). Adolescents' declining motivation to learn science: Inevitable or not? *Journal of Research in Science Teaching*, 48(2), 199-216. doi:10.1002/tea.20398
- Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, 25(1), 68-81. doi:10.1006/ceps.1999.1015

Chapter 2: The Role of Autonomy in Academic Motivation: Conceptualizing Varying Perspectives, Theories, and Evidence

Abstract

Autonomy has emerged as an important construct in educational and psychological research because students who feel autonomous often perform better and demonstrate more intrinsic or autonomous motivation. Although the autonomy construct is well established in the literature, educators and practitioners can be confused by the multiple definitions ascribed to autonomy and closely related constructs (e.g., choice). Definitions of autonomy support have also changed over time and include factors beyond supporting a student's need for autonomy. In addition, the research-based teaching implications for autonomy-related constructs are not always consistent. Given the confusion that can arise when trying to understand and interpret autonomy-related constructs and the associated teaching implications, the purpose of this paper is to identify and compare several constructs and explain the related implications for instruction. We first summarize multiple autonomy-related constructs. Then, we review three perspectives of autonomy related to academic motivation: (1) autonomy in self-determination theory, (2) the concept of autonomy support, and (3) the notion of choice. We conclude with recommendations for practitioners and researchers, including a call for more integrated conceptions of both the need for autonomy and academic motivation more generally, which focus on complex and dynamic patterns in individuals' motivation-related beliefs.

Autonomy has emerged as an important construct in educational and psychological research because students who feel autonomous tend to display more intrinsic motivation and higher achievement (e.g., Deci & Ryan, 2012; Deci, Schwartz, Sheinman, & Ryan, 1981). Although the autonomy construct is well established in the literature, educators and practitioners can be confused by the multiple definitions ascribed to autonomy and closely related constructs such as choice. For example, it can be difficult for scholars and educators to understand differences between autonomy, self-determination, locus of causality, volition, choice, and control. Furthermore, definitions of *autonomy support* have changed over time and include some factors beyond supporting a student's need for autonomy. In addition, the research-based teaching implications for autonomy-related constructs are not always consistent. For example, choices are often cited as a means for teachers to promote student autonomy, yet scholars do not always agree on whether there are different types of choices and, if there are, how these choices affect students' motivation and learning.

Given the confusion that can arise when trying to understand and interpret autonomy-related constructs and the associated teaching implications, the purpose of this paper is to identify and compare several constructs and explain the related implications for instruction. We begin by summarizing many of the autonomy-related constructs. Then, we review three perspectives of autonomy related to academic motivation: (1) autonomy in self-determination theory, (2) the concept of autonomy support, and (3) the notion of choice as an antecedent of perceived autonomy. We conclude with some recommendations for researchers and teachers. It is important to note that, although autonomy has been studied within a variety of domains and human motivation more generally, our primary focus is in the domain of education. However,

because autonomy is a capacious theme, a broader perspective is also important. Accordingly, we incorporate perspectives from several domains to complement those in education.

Definitions of Autonomy and Related Constructs

Various definitions of autonomy as a motivation construct exist, which are summarized in Figure 1. Some have simply defined autonomy as choice or decision-making (e.g., Iyengar & Lepper, 2000) and often use the terms “autonomy” and “choice” interchangeably (Ryan & Deci, 2006). Autonomy has been equated to self-determination and freedom through which individuals “mak[e] choices in the world to maximize [their] preferences” (Schwartz, 2000, p. 80). Others have put forth autonomy as independence and the expression of individualism (Markus & Kitayama, 1991), such that external influences (e.g., tradition) are inherently autonomy thwarting.

In self-determination theory (SDT), which is a main focus in the present paper, autonomy is defined as the psychological need to perceive that one’s behaviors are volitional, internally focused, and self-endorsed (Deci & Ryan, 2000). Autonomy is considered an experience that includes a sense of freedom and involves processes of integrating one’s behaviors with one’s sense of self (i.e., self endorsement). Autonomy in SDT is referenced as multiple states that depend on context, including a motivational state, motivation orientation, and a psychological need (Deci & Ryan, 2012, p. 86). Events intended to support autonomy do not necessarily foster autonomous feelings unless an internal locus of causality is perceived (Reeve, Nix, & Hamm, 2003). The SDT definition of autonomy is unique in several ways from other characterizations of autonomy. For example, unlike Markus and Kitayama’s (1991) conception, one can choose to fully endorse a notion such that it becomes part of one’s sense of self and is therefore autonomous; thus, if a tradition is fully endorsed, it is not considered autonomy thwarting.

Similarly, the freedom to pursue one's preferences is a limited view, as SDT posits that a self-determined individual can also decide to relinquish control so long as the decision to do so is fully endorsed (Deci & Ryan, 2000). Rather than choice equating to autonomy, choices are events that can support perceived autonomy and involve only part of the overall experience (Reeve et al., 2003).

There are also similar constructs to which the term "autonomy" is not always applied (see Figure 1). For instance, deCharms (1968) described *personal causation* as "the initiation by an individual of behavior intended to produce a change in his environment" (p. 6). Behaviors that are perceived as initiated by the self have an internal locus of causality and are considered intrinsically motivated (i.e., satisfaction is intrinsic to the task; deCharms, 1976). To be motivated, it is necessary that one is perceived as the cause or origin, and that a desired goal is actively achieved. Actions and consequences are perceived as originating from the self and the individual takes responsibility for them (deCharms, 1977). To be an origin of one's behaviors, one must experience choice (deCharms, 1977); hence, choice once again enters the broader conception of autonomy. Although somewhat similar, the SDT perspective of autonomy does not equate autonomy to locus of control; perceived locus is tied to a specific event and concerns where the cause of the behavior is derived, rather than the full experience of autonomy which includes integration of the behavior with the self (Deci & Ryan, 2000, p. 232). One might perceive an internal locus of causality although the behavior is coerced by internal influences (e.g., guilt, shame; Ryan & Connell, 1989).

Others have simply examined provision of *choice* as a motivation construct, with choice representing an event in which one selects among options (e.g., Patall, Cooper, & Robinson, 2008), or makes an action choice in which one might elect to, or decline, participation in the

choice-making (Reeve et al., 2003). They describe choice as an event or experience that can positively or negatively affect motivation (e.g., Patall, 2012).

The concept of *agency* from social cognitive theory is also related to autonomy. Agency is the perception that “one has the power to produce changes by one’s actions” (Bandura, 1999, p. 28) in which self-efficacy beliefs—perceived confidence in a task—are central. Agency is described by social cognitive theorists as the essence of motivation: without the belief that one can effectively pursue and attain a desired outcome, humans will lack motivation to act and persist (Bandura, 1999).

Finally, *learner autonomy* involves thinking and behaving with independence and autonomy in various environments (Littlewood, 1996). Again, this construct is connected to choice in that the individuals must both make and act on choices, which involves two elements: (a) ability, which requires knowledge of choice options and the necessary skill or competence for accomplishing or acting on the selection; and (b) willingness, which involves motivation for choosing and the confidence to act on the selection (Boud, 1981; Littlewood, 1996). Learner autonomy is an orientation describing behaviors favored by a learner, albeit often those that might be expressed by a person with high autonomous motivation. However, motivation to make choices is only a facet of learner autonomy.

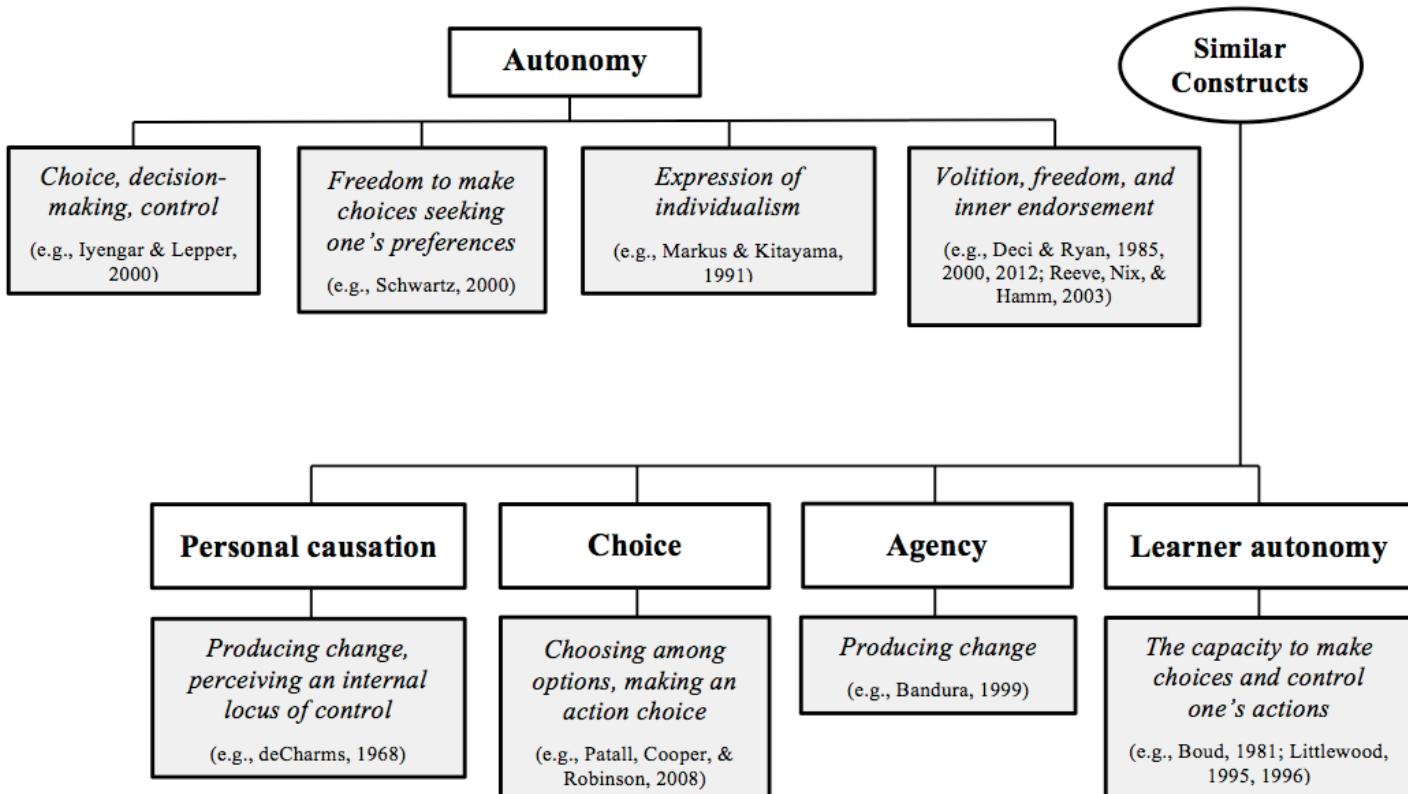


Figure 1. Summaries of several of definitions of autonomy and related constructs, specifically those theories that focus to some extent on academic motivation. It is important to note that this list is not comprehensive; with intention, we did not include constructs and theories that do not directly relate to academic motivation (e.g., self-actualization; Maslow, 1943). Our intention by developing this figure and discussing these constructs in the text was to compare and contrast several well-known notions that concern autonomy and academic motivation.

Although autonomy and these related concepts have been investigated frequently in research, the concept of autonomy is not universally accepted. For example, behavioral theorists (e.g., Skinner, 1971) suggest that the concept of autonomy is flawed, and that behavior is affected only by environmental stimuli such that locus of causality is inherently external. Similarly, the social psychologist Wegner (2002) posited that conscious will is a deception of our

own minds; although we believe one's conscious decisions influence one's actions, unconscious neural and psychological processes (often influenced by external stimuli) are more influential.

Overall, the characterization of autonomy often differs by researcher. Some of these differences can be minor, such as the importance of making choices in the model (e.g., Deci & Ryan, 1985; Reeve et al., 2003), or more disparate, such as weight on expressing individualism vs. self-endorsement of values (Deci & Ryan, 2000; Markus & Kitayama, 1991). These discrepancies may be due to the function autonomy serves in each definition. Autonomy has been described as an experience, a behavior, a state of being, a perception, and an orientation, which often changes throughout one's lifetime and within different contexts (Graves & Larkin, 2006). In addition, autonomy has been examined as a motivation construct outside of education, such as in work places, in terms of parenting and familial relationships, and for psychotherapy (e.g., Su & Reeve, 2011; Williams & Deci, 1996). In the end, Ryan and Deci (2006) submitted that "definitional confusion, catchy popularization, or overgeneralizations, some inappropriately dismiss the meaning, functional importance, and applied significance of human autonomy" (p. 1559). For the purposes of this paper, we will primarily focus on the self-determination theory definition upheld by Deci, Ryan, and their colleagues, which I describe further in the following sections.

Self-Determination Theory and Autonomy

The SDT perspective is one of the better known and cited theories that incorporates autonomy. To introduce autonomy in SDT, we first review the overall theory to illustrate the role of autonomy in relation to other SDT constructs. According to SDT, autonomy, competence, and relatedness are the innate psychological needs that are necessary for developing and maintaining human motivation and psychological well-being, and directing one's goals (Deci & Ryan, 2000). Although the psychological needs are considered universal, their manifestation as behaviors can

be culture-dependent and vary among individuals (Deci & Ryan, 2000, 2012). Regardless of the disparity of these psychological needs among individuals, evidence suggests they are universal human qualities demonstrated across cultures (Chirkov, Ryan, Kim, & Kaplan, 2003; Deci, Ryan, et al., 2003), phase of life (e.g., Kasser & Ryan, 1999; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Sheldon, Ryan, & Reis, 1996), and domain (Milyavskaya & Koestner, 2011).

Need satisfaction has been associated with improved psychological well-being, psychological functioning, and health (Deci & Ryan, 2000, 2012; e.g., Ilardi, Leone, Kasser, & Ryan, 1993; Kasser & Ryan, 1999). Conversely, when needs are thwarted, one's psychological functioning is less than optimal (Deci & Ryan, 2000, p. 254). Although SDT stipulates three needs, our focus is largely on only autonomy; it is not within the purposes of this review to do more than briefly define relatedness and competence. Relatedness refers to one's "desire to feel connected to others—to love and care, and to be loved and cared for" (Deci & Ryan, 2000, p. 231), and competence is one's perceptions of efficacy in completing a task or activity.

SDT is presented from the *organismic* perspective, thus centering on the psychological level (Deci & Ryan, 2000). The organismic perspective assumes a stance concerned with biological growth and development of certain elements that are essential to the advancement of the individual. As opposed to behaviorist ideology, which posits the stimulus-response process (e.g., Skinner, 1971), organismic theories of psychology concern psychological implications as "wholes" and, hence, reactions are considered extremely complex (Seltsam, 1931). It logically follows that, as a theory focused on the whole organism in which behaviors are derivative of all experiences (Seltsam, 1931), the needs proposed by SDT are interactive in nature. Thus, all three psychological needs are considered essential; they cannot necessarily be understood entirely as isolated elements, are not mutually exclusive, and interact with one another. Moreover, SDT assumes the needs are

innate, much like physiological needs (Deci & Ryan, 2012). Accordingly, when one need is not met or is thwarted, psychological functioning as a whole is hindered, causing “nonoptimal psychological outcomes” (Deci & Ryan, 2000, p. 229). In pursuit of these needs, the organism is naturally oriented toward growth in that one seeks action that will satisfy needs or some other goal directly or indirectly (Deci & Ryan, 2000, p. 229). Humans do not always consciously intend to satisfy their psychological needs; however, at times they can directly target their needs (consciously or unconsciously), especially when the needs are obviously unsatisfactorily met. Negative consequences occur if one targets need satisfaction and is unsuccessful (Deci & Ryan, 2000). Yet, a need does not have to be in some way deficit for one to actively behave in a way that satisfies the need, as need satisfaction is considered a natural and enduring life process. Again this behavior may not be conscious; “rather, they will be doing what they find interesting or important” (Deci & Ryan, 2000, p. 230), which may then result in actively seeking need satisfaction because past experiences indicate that such behaviors may result in something enjoyable or satisfying.

Multiple social contexts can affect how needs are satisfied or thwarted (Deci & Ryan, 2012). In education, these roles can be direct (e.g., the teacher-student relationship) or more distal or indirect (e.g., instructional methods chosen by teachers that facilitate or disrupt need satisfaction, or even instructional tools imposed on teachers by the even more distal social context of the local school board administration).

Internalization, Autonomous Motivation, and Intrinsic Motivation

In SDT, motivation exists on a continuum from extrinsic to autonomous. This continuum involves an internalization process whereby extrinsically influenced values can be assimilated intrinsically into one’s sense of self (Deci & Ryan, 2000), and represents a continuum through which the locus of causality for volitional behaviors shifts externally to internally and represents a

move from external regulation toward self-regulation (Ryan, 1995). The intrinsic nature (i.e., “quality”) of motivation is considered most influential to positive student outcomes, rather than amount of motivation (Vansteenkiste, Lens, & Deci, 2006). A great deal of extrinsic/controlled motivation is considered far less significant and beneficial than autonomous motivation (Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009).

Internalization processes are organized into four elements (i.e., regulations): external regulation, introjection, identification, and integration, respectively (Deci & Ryan, 2000). *Amotivation*, or a lack of motivation, and *intrinsic motivation*, the most autonomous, both exist outside of this continuum (Deci & Ryan, 2000; Ryan, 1995). Figure 2 depicts internalization.



Figure 2. The process of internalization (Ryan, 1995). The arrows represent movement toward more internalized regulations and autonomous motivation. However, these processes are not unidirectional and exist on a continuum.

With amotivation, behaviors are not regulated to any extent and are thus wholly heteronomous (Ryan, 1995). *External regulation* “is the most basic form of extrinsic motivation” (Deci & Ryan, 1985, p. 134) in which individuals act due external contingencies controlled by others, such as rewards, punishments, and coercion (Deci & Ryan, 2000; Ryan, 1995).

Introjected regulations derive from the self but are extrinsically oriented, such as personal application of pride and guilt (Ryan, 1995; Ryan & Connell, 1989). Although the introjected

regulations stem from within, they are only partially assimilated (Ryan, 1995), as they have not integrated into the individual's self and so remain heteronomous (Deci & Ryan, 2000). More autonomous is *identified regulation*, in which behaviors are perceived as personally meaningful or valuable, and are somewhat more accepted as part of the self. However, their value, although part of one's identity, is not yet intrinsic and instead originates outside of the self (Deci & Ryan, 2000). *Integrated regulation*, while still a form of extrinsic motivation, is the most autonomous regulation, as it is fully assimilated with the self and entirely self-regulated (Ryan, 1995). Integrated regulation is distinctive in that the integration is inclusive of the whole individual and becomes part of one's identity (Ryan, 1995). Although not intrinsic motivation, identified regulation "results [in] self-determined extrinsic motivation" (Deci & Ryan, 2000, p. 236), the most autonomous form of extrinsic motivation.

Outside of this continuum is intrinsic motivation, considered an innate quality that is not developed or obtained through the process of internalization (Ryan, 1995); thus, it is similar to, but separate from, integrated regulation. Humans are innately active organisms with natural tendencies for developing intrinsic motivation (Deci & Ryan, 1985), which involves interest in an activity in which the individual freely chooses to engage and where extraneous encouragement (e.g., rewards, consequences) is not necessary (Deci, Betley, Kahle, Abrams, & Porac, 1981; Deci & Ryan, 1985, 2012). Accordingly, intrinsic motivation involves engagement in an activity or task for the rewards implicit in the task (e.g., enjoyment, interest; Deci, 1971; Deci & Ryan, 2012). The concept of intrinsic motivation is intertwined with the three psychological needs of SDT (Deci & Ryan, 2000). As with general human functioning, without need satisfaction, growth is hindered. Likewise, so too is intrinsic motivation, which requires that primarily autonomy and competence, and more distally relatedness, be satisfied (Deci & Ryan,

1985, 2000). Intrinsically motivated behaviors do not necessarily seek psychological need satisfaction; however, intrinsic motivation thrives when psychological needs are met and diminishes when they are dissatisfied (Deci & Ryan, 2000, 2012). At the same time, satisfying the needs for competence and autonomy does not determine intrinsic motivation—it simply lays groundwork conducive to the development of intrinsic motivation (Deci & Ryan, 1985, 2000, 2012). Further, “a secure relational base appears to provide a needed backdrop—a distal support—for intrinsic motivation . . . [which] makes expression of this innate growth tendency more likely and more robust” (Deci & Ryan, 2000, p. 235).

Intrinsic motivation is considered optimal motivation (Deci & Ryan, 2012). Accordingly, intrinsically motivated students often perform better, learn at higher levels, are more engaged, persist, and demonstrate other positive outcomes such as improved health and well-being than students with more extrinsically-oriented motivation (Deci & Ryan, 2000, 2012; Deci et al., 1981; Patal, Sylvester, & Han, 2014; Reeve & Nix, 1997). Likewise, more autonomous motivation in general (i.e., highly internalized extrinsic motivation, integrated regulation) positively predicts learning, performance, persistence across domains, and other more general outcomes like overall well-being (Deci et al., 1991; Deci & Ryan, 2000, 2012; Ryan, & Deci, 2006; e.g., Vallerand et al., 1997).

The Role of Autonomy in Self-Determination Theory

Autonomy in SDT has roots in research such as deCharms’ (1968) locus of causality—or serving as the *origin* of one’s actions rather than a *pawn* that is influenced largely by external stimuli—and the idea that humans are naturally motivated to influence one’s environment and behaviors. Also related are concepts such as self-actualization (Goldstein, 1939; Maslow, 1943) and intentionality (Lewin, 1951). Within SDT, *Autonomy* is the need to feel that one’s behavior

is volitional, internally focused, and self-endorsed (i.e., it is integrated with one's sense of self), and is the "capacity for and desire to experience self-regulation and integrity" (Deci & Ryan, 2012, p. 85). Being autonomous involves feelings of volition and willingness, and the perception that one's behaviors are congruent with the self (Deci & Ryan, 2012).

Self-determination is the experience; it "is the capacity to choose and to have those choices, rather than reinforcement contingencies, drives, or any other forces or pressures, be the determinants of one's actions" (Deci & Ryan, 1985, p. 38). Conceptualization of self-determination, the theory's namesake, relies on perceived choice, which is directly related to one's awareness that a behavior is elicited internally or externally, as perceived on a continuum (Deci & Ryan, 1985). To be self-determined is to behave due to an internally-oriented choice (i.e., an internal locus of control), as opposed to an external force or stimulus that encourages action (i.e., external locus of causality). These intentions are autonomously controlled, which involves "freedom from control" (Deci & Ryan, 1985, p. 30). Autonomous functioning, then, is core to experiencing self-determination (Reeve et al., 2003). Perception is fundamental to autonomy and self-determination, as, regardless of whether a person is or is not controlled, it is the individual's perception that determines the psychological implications.

Reeve et al. (2003) described three "qualities" of self-determination: perceived locus of causality, volition, and choice. Others have incorporated both volition and perceived locus of causality, but cite personal values rather than choice (e.g., Deci & Ryan, 1987). When the three qualities of self-determination were isolated, Reeve et al. (2003) found that locus of causality and volition together (rather than in isolation) were more significant predictors of intrinsic motivation. An internal locus of causality by itself was not sufficient to induce self-determination, as behaviors controlled by internally-focused intentions may derive from

coercion—an internal locus with a lack of volition (Reeve et al., 2003). After examining the interrelatedness and distinctions among the three qualities, the researchers also presented a new definition of choice to include *action choice*, or a volitional decision in which one chooses to act or not. An action choice is not just selecting among options, as such behaviors may still be coerced. Instead, an internal locus and perceived volition are key (Reeve et al., 2003).

To clarify, the notion of control is related to self-determination; however, the concepts are different. Although control is a precursor to, and necessary condition of, self-determination, control in itself does not guarantee autonomous functioning (Deci & Ryan, 1985). Individuals can be forced to exert their control; consequently, the control enacted was pressured and thus not self-determined (Deci & Ryan, 1985; Reeve et al., 2003). Because choice is essential to self-determination, one might choose to relinquish control or to take control. One's choice to be directed by others or some external locus can be considered self-determined behavior because the individual has actively chosen to be controlled, rather than the course of action being imposed (Deci & Ryan, 1985; Iyengar & Lepper, 1999). Thus, "people's autonomy lies not in being independent causes but in exercising their capacity to reflectively endorse or reject prompted actions" (Ryan & Deci, 2006, p. 1574).

Autonomously motivated or self-determined individuals often show improved learning, engagement, self-regulation, well-being, self-efficacy, persistence, preference for challenge, and a variety of other positive outcomes (Deci & Ryan, 2000; Grolnick & Ryan, 1987, 1989; Kasser & Ryan, 1999; Ryan & Grolnick, 1986; Vallerand, Fortier, & Guay, 1997). In addition, autonomous individuals experience more intrinsic motivation (Deci & Ryan, 1985, 2000).

The Significance of Autonomy in Self-Determination Theory

Within SDT, autonomy is fundamental when the objective is to achieve integrated regulation or intrinsic motivation (i.e., higher quality motivation). SDT contends that all three psychological needs are interactive and affect one another, which in turn affects intrinsic motivation. However, each component may function in a different capacity, as Deci and Ryan (2012) explained, “Whereas perceived competence is necessary for any type of motivation, perceived autonomy is required for the motivation to be intrinsic” (p. 235). Indeed, intrinsic motivation is often measured through a period of free choice. Furthermore, “only when people’s feelings of relatedness and competence result from behaviors that are autonomous—behaviors that emanate from the self—will the people display optimal engagement and psychological well-being” (Deci & Ryan, 2000, p. 243). Intrinsic motivation requires that a behavior be fully self-determined and extrinsically motivated behaviors, as the term suggests, are derived from less autonomous means (Deci, 1971). Autonomy, then, is considered the key factor in determining the extent to which a behavior is extrinsically motivated (Deci & Ryan, 1985; Vansteenkiste et al., 2009), and the more intrinsic or autonomous motivation is, the higher the quality (Vansteenkiste et al., 2006). Therefore, general assessment of motivation, regardless of type, is considered less important to understanding the function and quality of motivation-related outcomes (e.g., engagement, performance) than is understanding the extent to which motivations are autonomous or externally controlled (Deci & Ryan, 2012, p. 86). This concept further aligns with the SDT perspective that psychologically healthy individuals will naturally pursue autonomous functioning and self endorsement (Deci & Ryan, 2012).

Nevertheless, Deci and Ryan (1985, 2000, 2012) expounded upon the importance of meeting all three psychological needs for positive functioning. If, without autonomous

experiences, feelings of relatedness and efficacy alone or in combination cannot produce conditions conducive to optimal vitality and self-actualization, nor can autonomous experiences likewise result (Deci & Ryan, 2000), then, following this, autonomous experiences should also be bereft when competence and/or relatedness are thwarted. This raises the question: If all three needs are inexorably intertwined, how can one element reign over the others? Others have posited that satisfying the need for autonomy may be more important for motivation in terms of only some motivation-related perceptions (e.g., utility value) but not others (e.g., intrinsic value/interest; Patall, Dent, Oyer, & Wynn, 2013). Moreover, Iyengar and Lepper (1999) submitted that the most salient motivator varies between cultures. In the end, although some motivation theorists and researchers disagree about the optimal psychological need for positive functioning, within most SDT literature, autonomy appears paramount.

Practical Educational Implications

Given that need satisfaction and intrinsic motivation can be fostered externally (Deci, Koestner, & Ryan, 2001), it is possible for teachers to support students' psychological needs and autonomous motivation. In this section, we include several implications for both nurturing the three psychological needs and autonomous motivation.

Autonomy and values. When students are self-determined, behaviors are considered fully endorsed, which means that students value what is pursued (Deci & Ryan, 2000). An autonomy orientation involves regulating one's actions according to values endorsed by the self and personal interests (Deci & Ryan, 2000). Thus, one does not feel fully autonomous without valuing or endorsing one's actions. The notion of *values* is present in multiple conceptions of motivation (e.g., expectancy-value theory, Wigfield & Eccles, 2000) and comprises such notions as individual interests, personal goals, and perceived utility. Because individuals can feel

autonomous even when they fully endorse relinquishing control to others (Deci & Ryan, 2000), it follows that a task pursued autonomously can lack personal value (e.g., interest or relevance) so long as the act of surrendering autonomy was fully endorsed.

As only some values are innate, individuals develop values through the process of internalization and integrate them with the self, which makes it possible to behave volitionally, or in a manner fully endorsed by the self (Ryan, 1995). Hence, the more one values something (e.g., a task, topic, or activity), the more internalized the regulations are considered. Autonomy is especially important in the internalization process, as it must be supported in the environment for integration and self-endorsement of values and regulations to occur. Perceived competence and relatedness alone can account for introjected regulations only (Deci & Ryan, 2000). Accordingly, it is implied that values are a means to an end; an individual can value tasks, feel competent, and feel relatedness, but still can lack autonomy if there is some perception of being controlled. Value, therefore, is one aspect of experiencing self-determination and acting autonomously. Through the process of becoming autonomous, values can be defined.

SDT posits that simply providing opportunities to act autonomously is insufficient; it is more important to provide opportunities for autonomy that align with students' values and goals (Deci & Ryan, 2000). However, there has been some confusion in explaining autonomy and values. In one account, researchers have explained that autonomy arises from activities that are valued,

When students believe that the content of the curriculum and the design of instruction provide opportunities for self-exploration and when the activities provided are meaningful, relevant, and related to personal interests and goals (Finn & Voelkl, 1993), they feel a sense of autonomy. (Wang & Eccles, 2014, p. 14)

Similarly, others noted that “people experience a sense of autonomy when they can realise their personal goals, values and interests” (Assor, Kaplan, & Roth, 2002, p. 262). Yet, additional motivation resources that can lead to autonomy are missing from these descriptions, such as the needs for competence and relatedness. Moreover, it is important to clarify that perceived meaning, relevance, and interest can be nurtured by a teacher and internalized by students; these values need not be predispositions to affect autonomous motivation (e.g., Hidi & Renninger, 2006). When students already value a task, they may be more apt to pursue the task in an autonomous fashion (Deci & Ryan, 2000, p. 245). However, teachers can also support students in integrating their values if the needs for competence, relatedness, and, most importantly, autonomy are satisfied. Accordingly, rather than teachers purely capitalizing on students’ interests and goals, they may also facilitate students’ active development of values for learning tasks. Finally, teachers should not only attempt to uncover students’ goals and values but also understand why the goals and values are pursued (Deci & Ryan, 2000).

Functional significance. *Functional significance* is a form of psychological meaning that one applies to an event, perceived uniquely by each individual (Deci & Ryan, 1987), which can facilitate or undermine intrinsic motivation (Deci & Ryan, 1980). Externally-oriented events have two aspects—controlling and informational—and either the controlling or informational aspect will be perceived as functionally significant or, rather, the relevant aspect of the event (Koestner, Ryan, Bernieri, & Holt, 1984). When the informational aspect of the event is salient or the event is perceived as “provid[ing] effectance-relevant information with the context of experienced autonomy or choice” (Koestner et al, 1984, p. 234), intrinsic or autonomous motivation is nurtured because the locus is internal. When the event is perceived as essentially

controlling (e.g., through introduction of a reward or consequence), autonomous motivation is undermined because the locus is turned outward (Deci & Ryan, 2000; Koestner et al., 1984).

Evidence indicates that teachers' and students' perceptions of the provision of choices in class, for instance, can vary widely (e.g., Gentry, Rizza, & Owen, 2013; Wolfson & Nash, 1968), and teachers' attempts to provide autonomy can fall far from the mark. Furthermore, when examining teacher behaviors and their effects on student outcomes and perceptions, Ryan and Grolnick (1986) found that student perceptions of classroom climate in general varied widely among individuals. Because each child experienced the classroom in a unique manner, each also perceived the functional significance of its climate per their individual experiences, which in turn affected self- and motivation-related outcomes. Consequently, assessing the functional significance of the classroom environment per student, regardless of the teacher's or classroom's overall autonomy orientation, is important (Ryan & Grolnick, 1986).

Extrinsic rewards. External rewards, even when presented in a positive manner, can undermine intrinsic and autonomous motivation. This notion first appeared in Deci's (1971) laboratory experiment where participants' good performance on a task was rewarded with money or verbal encouragement and positive feedback. Intrinsic motivation was negatively affected by money but positively affected by verbal reinforcement and positive feedback. These findings have been confirmed in more recent research (e.g., Deci et al., 2001).

In addition to provision of rewards and consequences, other external causes (e.g., deadlines, competition, surveillance, high-stakes testing) can negatively impact autonomous motivation (Deci, Betley, et al., 1981; Deci & Ryan, 1985; Patal et al., 2008; Ryan & Weinstein, 2009). Individuals with more internal causality orientations, however, are less susceptible to the

undermining effects of extrinsic rewards (Hagger & Chatzisarantis, 2011), which emphasizes the importance of nurturing autonomy-orientations in students.

Researchers have also examined the effect of different types of feedback on intrinsic motivation, particularly focusing on the interaction of perceived autonomy and competence (e.g., Deci & Ryan, 1985). Individual motivation for the task itself requires both autonomy and competence, whereas extrinsic motivation does not, and it is the perception of those forces that affect the autonomous nature of the motivation. Positive instructor feedback that supports competence beliefs can positively affect intrinsic motivation (Deci, 1971; Deci & Moller, 2005), although its effects are constructive only so long as autonomy is nurtured (Ryan, 1982; Deci & Moller, 2005). Controlling feedback, even when expressed as positive in nature (e.g., “Excellent! You did exactly what I asked you to do!”), can have detrimental effects on autonomous motivation (Ryan, 1982). Furthermore, the functional significance of informational feedback might be considered either controlling (e.g., when the individual perceives the feedback is intended to elicit similar behavior in the future) or affirming per the receiver’s perception and so the same feedback might either negatively or positively influence autonomous motivation per individual (Deci & Moller, 2005).

Autonomy and competence. Within SDT, competence support is considered a necessary prerequisite to optimal experiences of autonomy (Deci & Ryan, 1985), which are associated with increased academic performance, persistence, and other beneficial outcomes (Deci & Ryan, 2000). As evidence, Tai, Sadler, and Maltese (2007) found that low competence combined with high freedom during learning tasks had a negative impact on student outcomes later in their academic careers. However, when more competent students were provided with autonomy, their later performance was not negatively affected (Tai et al., 2007). Others have documented that

lower performing students and those with poorer strategy use often prefer less autonomy (e.g., Könings Brand-Gruwel, & Elen, 2012). Moreover, perceived autonomy and perceived competence are generally positively related (e.g., Cordova & Lepper, 1996; Williams & Deci, 1996), as are preference for autonomy and competence beliefs (Könings et al., 2012; Lin, Liang, Su, & Tsai 2013), although the exact origins of these relationships are unclear. Findings such as these indicate that teachers may need to regulate the amount of autonomy they offer students depending upon their levels of competence. Moreover, teachers should consider both students' performance on learning tasks and their perceived competence.

In the end, internalization of regulations is a process that can be influenced by others. Because autonomy plays an integral role in intrinsic motivation, certain autonomy supportive interpersonal behaviors have been found to facilitate internalization (e.g., Deci, Enghardi et al., 1994; Ryan & Connell, 1989). In the following sections, we review practical implications for affecting students' perceived autonomy through "autonomy support" and "choice."

Autonomy Support

Because environmental factors can support students' self-determination (Deci & Ryan, 1985), researchers have examined the role of *autonomy support* within the context of education to meet students' psychological need for autonomy and to foster their self-determination. In light of Deci and Ryan's (1980) position that controlling external events in an environment can undermine intrinsic motivation, Deci, Schwartz et al. (1981) developed and tested the validity and reliability of their Problems in Schools instrument, designed to assess teacher characteristics—controlling or autonomy-supportive—to examine which teacher behaviors undermined students' autonomous motivation. The instrument assessed teachers' control orientations by providing short vignettes paired with four possible responses existing on a continuum ranging from "highly autonomous" to

“highly controlling” (Deci, Schwartz et al., 1981). Autonomy supportive behaviors were those that generally encouraged self-initiation and autonomous pursuits. They found that teacher orientations were positively related to students’ perceptions of the autonomous vs. controlling features of the environments; further, students performed better in the autonomy supportive classrooms, and control-oriented teachers negatively impacted students’ intrinsic motivation (Deci, Schwartz et al., 1981). Accordingly, these researchers and others (e.g., deCharms, 1976; Deci, Nezlek, & Sheinman, 1981; Hardre & Reeve, 2003; Koestner, Ryan, Bernieri, & Holt, 1984) have examined the role of autonomy supportive teacher behaviors, and over time, the definition of autonomy support has become more clearly defined.

When examining the influence of parenting style on children’s self-regulation and school achievement, Grolnick and Ryan (1989) defined autonomy support as interpersonal techniques that nurture “independent problem solving, choice, and participation in decisions” (p. 144). The researchers used three component scales to measure the amount of autonomy support evident in interviews with parents: *values autonomy*, involving the parents’ value of the child having autonomy in parent-child interactions; *autonomy-oriented techniques*, including disciplinary styles that promoted autonomy (e.g., rationales, understanding feelings); and *nondirectiveness*, concerning provision of choice and inclusion in decision-making (Grolnick & Ryan, 1989). In this case, autonomy support was still somewhat ambiguous and suggestive of any interpersonal behaviors that encouraged autonomous behaviors (e.g., choice, self-initiation, rationales, decision-making; Grolnick & Ryan, 1989).

Deci, Eghrari, Partick, and Leone (1994) were the first to define autonomy support as a construct for the purposes of experimental manipulation and described it as interpersonal relationships that support, welcome, and encourage a variety of self-determined behaviors in

others (e.g., self-initiation, autonomous choice-making) to promote internalization rather than assuming a controlling, coercive stance when interacting with others (Deci et al., 1994, p. 123). They found that interpersonal behaviors that supported self-determination promoted internalization while controlling behaviors had the opposite effect. More recently, researchers have worked to refine Deci et al.'s (1994) work. Pertaining to education, the definition has expanded and autonomy-supportive educators are described as those who recognize, identify, and support students' innate psychological needs (i.e., competence, autonomy, and relatedness) in addition to their internalized motivators, including personal values, interests, and preferences (Reeve, 2006; Reeve & Jang, 2006). Autonomy support is accomplished by facilitating an educational environment in which students can rely on "internal resources" to direct and manage their behaviors with volition and an internal locus of causality, as opposed to a controlled, externally regulated environment not influenced by inner strivings (Reeve, 2006; Reeve & Jang, 2006). SDT influenced both definitions: Deci et al. (1994) suggested that autonomy supportive behaviors are important to internalization, while Reeve (2006) and Reeve and Jang (2006) included psychological needs as integral elements of autonomy support. In other words, autonomy supports accommodate innate and internalized factors and, in turn, motivation to engage can develop (Reeve, 2006). The fundamental objectives of self-determination within the learning environment are "intentions to act" (Reeve & Jang, 2006, p. 216), or directing and managing one's own behavior. This conception of autonomy-support integrated additional aspects outside of the three inherent psychological needs, including the influence of a variety of sources individual to each person (e.g., culture, upbringing, lived experiences) from which internalized autonomous functioning stems.

Conditions of Autonomy Support

While autonomy—or experienced self-determination—is the overarching goal of autonomy support, researchers have put forth an array of conditions that can lay the groundwork for supporting perceived autonomy. To create an environment that nurtures autonomy, researchers defined several conditions of autonomy supportive behavior. The first testable model examined three original conditions, or rather, “contextual events” that foster internalization (Deci et al., 1994, p. 124). These autonomy-supportive interpersonal interactions included “providing a meaningful rationale,” “acknowledging the behaver’s perspective,” and “conveying choice rather than control” (Deci et al., 1994, p. 124)—in short: *rationale*, *acknowledgment*, and *minimizing pressure and conveying choice*. They found that the three conditions of autonomy support were not mutually exclusive; presence of all three predicted perceived autonomy. Later, Su and Reeve (2011) described the third element—minimizes pressure and conveys choice—more specifically as “noncontrolling language” (p. 160) because Deci et al. (1994) measured noncontrolling communications (i.e., phrasing) when assessing that component of autonomy support. A fourth interpersonal condition was eventually added, *nurture inner motivational resources* (Reeve, 2006; Reeve, Jang, Carrell, Jeon, & Barch, 2004) and the original three terms were revised (Reeve, 2006): “nurture inner motivational resources” (p. 229); “communicate value and provide rationales” (p. 230); “acknowledge and accept . . . expressions of negative affect” (p. 230); and “rely on informational, noncontrolling language” (p. 229). Finally, in their meta-analysis of interventions for developing an autonomy-supportive interpersonal style, Su and Reeve (2011) cited a fifth condition: “offer choices” (p. 162), which appeared in the operational definition of autonomy support in 14 of the 19 publications they studied (Su & Reeve, 2011). See

Table 1 for a summary of each condition of autonomy support. Next, I define these conditions of autonomy support and briefly review how each element developed into its current definition.

Table 1

The Five Conditions of Autonomy Support and Example Sources

Autonomy support conditions	Example supports	Example publications
Nurture inner motivational resources	<ul style="list-style-type: none"> • Support the sense of perceived autonomy • Support perceptions of competence • Support the sense of relatedness in the classroom • Target personal interests and goals 	Reeve, 2009 Su & Reeve, 2011
Communicate value and provide rationales	<ul style="list-style-type: none"> • Offer meaningful rationales • Communicate value and utility • Align tasks with goals and interests 	Deci et al., 1994 Reeve, 2006
Acknowledge and accept expressions of negative affect and perspectives	<ul style="list-style-type: none"> • Acknowledge negative perspectives and feelings toward tasks • Display empathy • Explain how tasks will not interfere with personal goals • Show respect for individual perspectives 	Deci et al., 1994 Reeve, 2006
Rely on informational, noncontrolling language	<ul style="list-style-type: none"> • Use noncontrolling language that expresses action choice (e.g., “if you want,” “you can”) • Avoid controlling language (e.g., “you must,” “you should”) • Use informational language • Affirm competence • Explain the “why” and “what” of the task 	Deci et al., 1994 Reeve, 2006 Su & Reeve, 2011
Offer/convey choice	<ul style="list-style-type: none"> • Provide opportunity to make choices • Offer the freedom to choose to act or not act (i.e., action choice) 	Deci et al., 1994 Su & Reeve, 2011

Nurture inner motivational resources. Humans are considered active beings who are naturally motivated to pursue certain activities; in other words, individuals have certain “inner resources” (Reeve, 2009, p. 168) that give their behaviors energy and direction. Accordingly,

promoting those resources is considered autonomy supportive behavior and involves encouraging several factors when engaging an individual in a task or activity: (a) a sense of personal autonomy, competence, and relatedness; (b) personal interests and goals; and (c) other individual influences, such as inciting curiosity and enjoyment (Reeve, 2009; Su & Reeve, 2011). Self-determination theory posits that the environment must support all three psychological needs for one to function autonomously (Deci & Ryan, 2000). Further, autonomous behaviors are self-endorsed, meaning that values like interests, goals, and/or enjoyment are present. If values are not innate (as in intrinsic motivation), they can be internalized through a process that can be influenced by others (Ryan, 1995).

Communicate value and provide rationales. Conveying the personal utility and value of a task, especially tasks in which students lack interest or value (e.g., memorizing multiplication tables), is considered important to nurturing autonomy (Deci et al., 1994; Reeve, 2009). This condition stems from the notion of internalization, in which one develops values and integrates them with the self, making it possible to function autonomously. Providing rationales that are both informative and personally meaningful is vital, especially those that consider the individual's personal perspectives, values, goals, and/or interests (Reeve, 2009). This condition reflects the reasons why a task is completed (Deci et al., 1994): What is the value or utility gained by engaging in the potentially boring task? "Not all lessons, classroom procedures, and behavioral requests can be inherently interesting and need-satisfying things to do" (Reeve, 2009, p. 169). Offering rationales can help assuage a lack of interest or negative perceptions. For instance, when in elementary school, learning multiplication tables might lead to more interesting activities in which one could utilize those multiplication tables (e.g., appealing math game). Or, memorizing multiplication tables might help the student meet personal future goals

by making later, more complicated mathematics formulas more attainable. Thus, completing the boring math drills now will benefit later, more desirable outcomes or events.

Acknowledge and accept expressions of negative affect and individual perspectives.

Little has changed since Deci et al. (1994) first described this element as acknowledging perspectives and displaying empathy for and understanding of conflicts with personal goals, as well as how the requested task may be completed without disrupting those goals. When a task requires a rationale due to some lack of interest or value or conflict with personal goals, acknowledging and accepting the (potential for or presence of) negative affect can communicate respect for the individual's freedom in holding those feelings, which are both valid and normal. "Thus, it can help alleviate the tensions and allow the person to understand that the requested behavior can harmoniously coexist with his or her inclinations" (Deci et al., 1994, p. 124).

Use informational, noncontrolling language. Initially describing events that minimize pressure and express choice, this condition of autonomy support was originally defined by Deci et al. (1994) as the approach adopted when presenting rationales and acknowledging feelings. Only later was it rephrased as utilizing informational and noncontrolling *language* (Su & Reeve, 2011). Focusing instead on mode of communication, phrasing was considered the integral component when minimizing pressure and expressing choice (Su & Reeve, 2011). Controlling phrasing comprises terms like "you need to" and "you must," while noncontrolling language is more neutral and communicates autonomous choice, including phrases like "if you want" and "you can" (Deci et al., 1994). These flexible communications are both "information-rich" (e.g., focusing on the *why* rather than only *what*) and "competence-affirming" (Reeve, 2006, p. 229) in that the speaker attempts to align the student's internal locus of causality and motivational resources with the task at hand without perceived coercion.

However, it is unclear if Deci et al. (1994) intended this condition more generally as a non-pressuring style, which could extend beyond language. Language was the means through which this element of autonomy support was measured; nevertheless, verbal language may not be a comprehensive view. Regardless, the construct was not examined by manipulating other behaviors that might also diminish pressure and communicate autonomous choice and was redefined to reflect the measurable components: informational and noncontrolling language (e.g., Hardré & Reeve, 2009; Reeve, 2006, 2009; Reeve et al., 2004). Su and Reeve (2011) meta-analyzed 20 interventions intended to facilitate an autonomy supportive motivating style. Of all measured conditions, informational and noncontrolling language had the highest effect size ($d = 0.943$), while the act of offering choices, for instance, represented the lowest ($d = 0.553$), indicating that aiming interventions more broadly at altering the manner of language is more effective. For example, the manner in which choices are communicated is critical, as simply providing opportunity for choice could be delivered in a controlling manner.

Offer/convey choice. Moving away from discussion of Deci et al.'s (1994) initial conception of choice, others defined this condition of autonomy support as clearly separate from informational and noncontrolling language. When offering choices to support autonomy, one should provide encouragement and opportunity for choice-making and self-determined actions, and openly communicate choice-making opportunities (Su & Reeve, 2011).

One perspective highlighted the significance of providing choice in a noncontrolling manner by means of a controversial topic, albeit one unrelated to education. Williams, Cox, Kouides, and Deci (1999) investigated autonomy supportive intervention designed to motivate students aged 14 to 18 years to refrain from or reduce their tobacco smoking. Offering choice involved first providing unbiased information and then showing respect for and support of the

individual's right to choose autonomously while encouraging their decision-making behavior (Williams et al., 1999). In this study, autonomy support was defined as those informational yet nonpressuring behaviors that communicate choice in smoking behaviors, and an unbiased communication of the potential hazards of smoking. Thus, asserting a coercive attitude in which choice is not respected might create a conflict in which this particularly important decision is compromised. Understanding this element of autonomy support in terms of a profound decision such as this is key; although both the individual and influencer may understand that one option is particularly detrimental (even to health), respecting the youth's right to choose is of utmost importance in preventing poor decisions made for the sake of asserting one's autonomy. Williams et al. (1999) found that their participants were less likely to engage (or continue) in smoking-related behaviors after participating in a noncontrolling version of a smoking intervention (i.e., the "It's Your Choice" presentation, as opposed to the "Fear-and-Demand" presentation; p. 960) if they perceived the functional significance of their instructor's behaviors as autonomy supportive.

Overall, nurturing inner motivational resources, communicating value and providing rationales, acknowledging and accepting expressions of negative affect, relying on informational and noncontrolling language, and offering choices are put forth as the five integral conditions of supporting autonomy. Next, I describe an autonomy supportive teaching style.

Autonomy Supportive Teacher Behaviors

Instructional style can be either controlling or autonomy-supportive, which is described on a continuum (Reeve, 2006; Reeve & Jang, 2006) and is manifest through interpersonal relationships and classroom events and activities with a range of features, such as challenge level, type of activity, and behavior management structure (Reeve, 2006). In addition to the five conditions of an autonomy supportive style, there is research on specific teacher behaviors.

Reeve and Jang (2006) examined “student” perceptions of “teacher” behaviors (in this lab-based study students and teachers were preservice teachers assigned to either role) as autonomy supportive or controlling. Participants were paired, and those acting as students completed a puzzle-solving task with guidance from the assigned teacher. Reeve and Jang (2006) found that students perceived eight teacher behaviors (of their original list of 11 hypothesized behaviors) as autonomy supportive: “time listening, time allowing student to work in own way, time student talking, praise as informational feedback, offering encouragement, offering hints, being responsive to student-generated questions, and making perspective-acknowledging statements” (Reeve & Jang, 2006, p. 214). “Offering encouragement, time allowing student to work in own way, and time student talking” (Reeve & Jang, 2006, p. 214) were positively associated with perceived autonomy and performance. Although several teacher behaviors were initially significant, they did not hold up to more rigorous statistical analysis, including “asking what student wants” (Reeve & Jang, 2006, p. 214), “creating seating arrangements to encourage students’ initiative and conversation” (p. 210), and “providing rationales” (p. 214). It is difficult to understand how providing rationales was not significant beyond the more stringent significance level ($p = .009$) considering that it is one of the five conditions of an autonomy supportive style. However, the authors posited that the nature of the lab-based activity—a purportedly interesting activity that may not have required a rationale—was likely responsible.

Although research has defined both specific teacher behaviors and conditions that nurture autonomy, students remain responsible for their self-determined endeavors (Reeve & Jang, 2006). Although instructors can set conditions that allow for autonomous functioning and encourage students to be self-regulated and autonomous learners, they cannot be forced or coerced into becoming self-determined. Students themselves must actively follow suit when an

environment is conducive to autonomous functioning. Following is a summary of empirical evidence on the positive effect of autonomy support and the functionality of training programs for developing an autonomy-supportive style.

Evidence for Autonomy Support

Many researchers have cited the benefits of nurturing students' autonomy through an autonomy-supportive instructional style, as well as aiming to teach instructors to cultivate and respect students' autonomy. In a recent publication, Reeve (2009) reviewed 44 empirically-validated studies spanning several decades of research, revealing a range of educational benefits. The positive outcomes comprised six categories: (a) motivation (e.g., intrinsic motivation, competence, relatedness), (b) engagement (e.g., attendance, intention to persist), (c) psychological development (e.g., self-esteem), (d) learning (e.g., self-regulatory strategies, higher order processing), (e) performance (e.g., achievement on tests, course grades), and (f) psychological well-being (Reeve, 2009, p. 162). Overall, findings revealed that supporting students' autonomy encourage positive functioning (Reeve, 2009). Research also indicated that individuals can learn to support others' autonomy (Su & Reeve, 2011). Su and Reeve's (2011) meta-analysis of intervention training programs showed a significant and robust effect size of intervention effectiveness ($d = 0.63$).

Another means to provide evidence for the conditions for autonomy support is to compare the conditions to other teaching strategies that have been found to foster students' motivation. Indeed, Reeve (2009), explained:

Teachers support a good deal more than the psychological need for autonomy when they support students' autonomy. Despite its seemingly narrow nomenclature, a teacher's autonomy-supportive motivating style nurtures not only students' need for autonomy (Reeve & Jang, 2006) but also students' needs for competence and relatedness (Ryan & Deci, 2000)

and inner motivational resources more generally (e.g., interests, preferences, temperament; Reeve, Deci, & Ryan, 2004). Empirical work bears out the assumption that the provision of autonomy support nurtures this fuller range of inner motivational resources. (p. 169)

One useful comparison is to the MUSIC Model of Academic Motivation (Jones, 2009) because it was developed specifically to organize research-based motivational strategies into a framework that could be understood and used by instructors. The focus of the MUSIC model is on strategies that can be used by instructors to increase students' motivation and engagement more broadly than the narrower focus of autonomy. The MUSIC model presents instructors with five key principles to summarize teaching implications: Students are more motivated when they perceive that they are *empowered*, they perceive that the content or activities are *useful*, they believe that they can be *successful*, they are *interested* in the topic or activities, and they feel *cared* for by others in the learning environment. The term MUSIC is an acronym for the five key components of the model: eMpowerment, Usefulness, Success, Interest, and Caring. When asked to rate these five components in regards to a class, upper-elementary to college students perceive them as correlated, yet distinct factors (Jones & Skaggs, 2012; Jones & Wilkins, 2013a, 2013b, 2015). Although the MUSIC model was developed based, in part, on self-determination theory, it was also informed by research related to a wide range of theories and constructs (for further explanation, see Jones, 2009), such as expectancy-value theory (e.g., expectancy for success, intrinsic interest value, attainment value, utility value; Eccles et al., 1983), social cognitive theory (e.g., self-efficacy; Bandura, 1986), attribution theory (Weiner, 1986), self-theories of intelligence (Dweck, 1999), self-worth theories (Covington, 1992), goal orientation theories (Ames, 1992), interest (Hidi & Renninger, 2006), flow (Csikszentmihalyi, 1990), competence motivation (Elliot & Dweck, 2005; White, 1959), caring (Noddings, 1992), and belongingness (Baumeister & Leary, 1995). See Figure 3 for relationships

between these constructs and the MUSIC model components. Other researchers have also used constructs similar to those in the MUSIC model in their studies to investigate the effects of the school environment on students' engagement (e.g., Turner, Christensen, Kackar-Cam, Trucano, & Fulmer, 2014; Wang & Eccles, 2013). Interestingly, a comparison of the five key components of the MUSIC model and related constructs from other motivation theories align quite well with the characteristics of autonomy support, as shown in Figure 3.

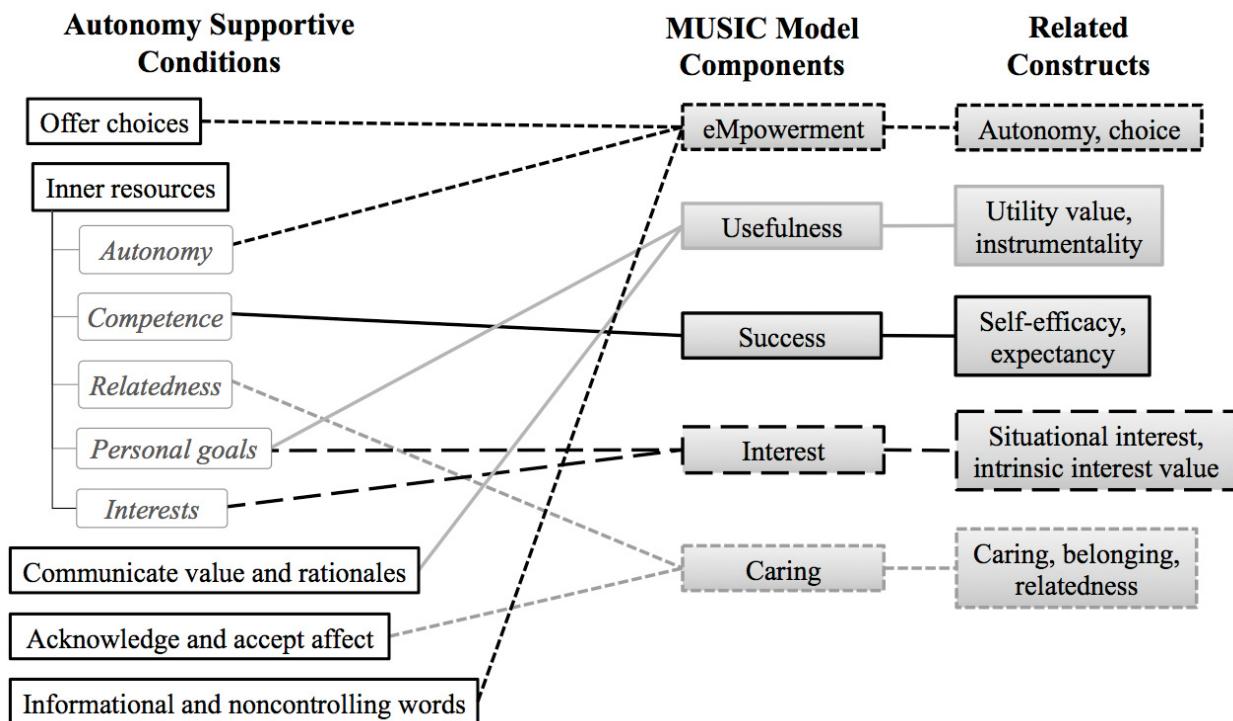


Figure 3. Autonomy support aligned with the MUSIC Model of Academic Motivation and other related motivation constructs.

In this section, we explain the connections in Figure 3 in the order shown by starting with the autonomy supportive conditions at the top and working towards the bottom of the figure. We limit our explanations to the connections shown in Figure 3 but acknowledge that other

connections are also possible. *Offering choices* is most directly related to teaching implications in the MUSIC model that encourage instructors to empower students by giving them some control over the learning environment. These strategies are based on research related to the need for autonomy and choice constructs. The “inner resources” of the *nurture inner motivational resources* condition incorporates the three psychological needs in SDT (i.e., autonomy, competence, and relatedness), personal goals, and interests. Again, autonomy is related to the teaching strategy of empowering students. The need for competence leads to teaching strategies that support students’ success and is based on research related to constructs such as self-efficacy (i.e., confidence in achieving a task; Bandura, 1986) and expectancies for success (i.e., how one expects to perform on future tasks; Wigfield & Eccles, 2000). Teaching implications for relatedness include instructors providing a caring environment, which is based on research related to concepts such as caring (i.e., the “one-caring” or “carer” is actively receptive to others’ perspectives and feelings and aims to support the other; Noddings, 1992), belongingness (i.e., a desire to form and sustain positive interpersonal relationships; Baumeister & Leary, 1995), and attachment (i.e., “a deep and enduring affectionate bond that connects one person to another across time and space”; Bergin & Bergin, 2009, p. 142). Aligning instructional behaviors with students’ personal goals and targeting their interests (including individual interests and situational interests by rousing both curiosity and enjoyment; Reeve, 2009; Su & Reeve, 2011), are consistent with instructional strategies based on other interest theories (e.g., Hidi & Renninger, 2006) and the concept of intrinsic interest value in expectancy-value theory (i.e., enjoyment experienced when engaging in a task; Wigfield & Eccles, 2000). Teaching implications related to personal goals are also consistent with implications for utility value in expectancy-value theory, which considers the relevance and usefulness of a task, such as when a task is consistent with personal goals (Wigfield & Eccles, 2000).

Continuing to examine Figure 3, *Communicating value and providing rationales*

corresponds with teaching strategies presented in the usefulness component of the MUSIC model and are consistent with research related to utility value in the expectancy-value theory (i.e., perceiving how the present task might align with one's goals and plans; Wigfield & Eccles, 2000) and instrumentality (i.e., the perception that completing the task will be important or instrumental to meeting a valued goal in the future; Miller & Brickman, 2004). An instructor who *acknowledges and accepts negative affect and individual perspectives* likely communicates that individuality is respected, which is related to teaching strategies that emphasize caring (Noddings, 1992) in that teachers communicate that they have sought to acknowledge and understand students' perspectives. Using *informational, noncontrolling language* can empower students by conveying autonomous choice.

In sum, the factors identified as autonomy supportive are consistent with teaching implications derived from other motivation research and theories, as summarized in the MUSIC model components. This consistency provides further evidence that autonomy supportive interactions reach beyond supporting the psychological need for autonomy and attend to other motivational resources. Recent empirical studies that have included several of the constructs in Figure 3 provide further evidence of the connection between these teaching strategies and students' motivation and engagement (e.g., Turner et al., 2014; Wang & Eccles, 2013).

Choice

The role of perceived choice in influencing academic motivation and, in particular, perceived autonomy, has garnered attention in motivational literature. It is important to examine the role of choice more closely for at least two reasons. First, as described earlier, there has been some debate surrounding choice as a condition of autonomy support. Second, ample research has

focused specifically on choice and motivation, with “choice,” at times, even used to define autonomy (e.g., Iyengar & Lepper, 2000). The following serves to clarify this concept and provide several perspectives on its role in motivation.

In education, choice involves students’ perceptions of opportunities to make decisions and offer input within their educational environments (Wang & Eccles, 2013). When considering choice, SDT is often used as a framework and source for defining autonomy (e.g., Assor et al., 2002; Katz & Assor, 2007; Patall et al., 2008; Patall, Cooper, & Wynn, 2010). “Self-determination means that people experience choice” (Deci & Ryan, 1985, p. 38) and provision of choice is intended to support psychological needs (Katz & Assor, 2007). Thus, the psychological roots of choice are considered similar to those of SDT and autonomy support, such as locus of causality (i.e., personal causation; deCharms, 1968) and self-actualization (Goldstein, 1939), although the origin of the concept is derivative of a variety of psychological and motivational theories (Patall, 2012).

Offering/conveying choice is one of the five conditions of autonomy support (Reeve, 2006), and teachers have reported that they often use choice as a means to motivate and engage students in learning (e.g., Flowerday & Schraw, 2003). Although the concept of providing choice appears straightforward at first blush, there are several important characteristics to consider: for instance, (a) choices should be meaningful (Assor et al., 2002; Katz & Assor, 2007; Patall et al., 2010; Reeve et al., 2003; Stefanou, Perencevich, DiCinto, & Turner, 2004; Williams, 1998), (b) individuals should have autonomy over how choices are realized (Patall et al., 2008; Patall et al., 2013; Reeve et al., 2003), and (c) a choice is effective provided that psychological needs are supported (Katz & Assor, 2007). As such, choices should not be offered in a highly controlling style. Rather, an action choice is considered beneficial in that feelings of volition are facilitated

when one chooses to act or not without perceived coercion (Reeve et al., 2003). As in Su and Reeve's (2011) interpretation of communicating choice (from Deci et al., 1994) as noncontrolling *language*, the language used is the means through which self-determination and, more broadly, psychological needs are supported as opposed to the choice (i.e., event). A meaningful choice also is not simply choosing a preferred notebook color; such choices are often considered superficial, trivial, or instructionally irrelevant and therefore considered ineffective in facilitating self-determination and nurturing psychological needs (Patall et al., 2008). However, some have posited that the opposite can also be true (Cordova & Lepper, 1996; Patall et al., 2008; Patall et al., 2013).

Empirical findings on the effect of choice have been equivocal, with some researchers indicating positive effects (e.g., Linnenbrink-Garcia, Patall, & Messersmith, 2013; Patall et al., 2010; Patall et al., 2013; Reber, Hetland, Chen, Norman, & Kobbelvold, 2009) and others describing neutral or negative effects (e.g., Reeve et al., 2003; Schraw, Flowerday, & Reisetter, 1998). As my interests here concern motivation, I will primarily report motivation-related outcomes in lieu of a comprehensive review, which details a wide range of effects from performance outcomes to affective outcomes. Patall et al. (2008) completed a meta-analysis of studies examining the effect of choice on multiple outcomes, including intrinsic motivation, "effort, task performance, subsequent learning, perceived competence, satisfaction, and creativity" (p. 277). Of the 91 studied effect sizes pertaining to the effect of choice on intrinsic motivation, 78 suggested a positive relationship with beneficial outcomes and only 13 were negative or neutral (Patall et al., 2013). Of the 14 that measured effect on effort, only five found negative relationships. Of the 11 studies that examined the effect of choice on perceived competence, all effects were positive. Patall et al. (2008) concluded that choice can have a positive effect on autonomous motivation, motivation-related outcomes like competence

perceptions and effort, and other similar outcomes such as achievement and “preference for challenge” (p. 294). Later, Reber et al. (2009) investigated the effect of choosing an instructional example from a list of options. Participants who were offered choice reported significantly higher interest ($p = .014$) and perceived control ($p = .037$). In addition, those presented with choice appeared more engaged in that they spent a significantly longer period of time reading than did participants without opportunity to choose (Reber et al., 2009). Linnenbrink-Garcia et al. (2013) similarly found that choice predicted both triggered and maintained situational interest, and that perceived choice was indirectly related to individual interest, engagement, and perceived competence. The most significant autonomy support in predicting situational interest was perceived choice (Linnenbrink-Garcia et al., 2013). However, choice was not related to values associated with maintained situational interest; a theme that has appeared in several studies suggesting that provision of choice is not always associated with individual values (e.g., Patall et al., 2010; Wang & Eccles, 2013), which are considered indicative of more autonomous motivation (Deci & Ryan, 2000).

Negative Conceptions of Choice

Although evidence exists to support the benefits of choice, others have argued against the concept for various reasons. For example, too much choice may create *cognitive overload* (Sweller & Chandler, 1994) or *choice overload* (Schwartz et al., 2002), leading individuals to be less satisfied with choices or prompting fatigue and choice avoidance (Rice & Hanoch, 2008; Ryan & Deci, 2006; Schwartz, 2000; Schwartz et al., 2002). Some have similarly advanced that humans maintain a limited store of inner resources through which volition is exerted in the form of making decisions, engaging in activities, and controlling behaviors (Baumeister, Bratslavsky, Muraven, & Tice, 1998). These volitional resources are restricted in that choice making expends resources that

cannot be utilized for future endeavors. Thus, the concept of *ego depletion* proposes that preliminary choices can negatively affect later persistence at more difficult volitional activities (Baumeister et al., 1998). Ego depletion stands in contrast to arguments that support meaningful choices, as the more volition exerted—such as that for important choices—the fewer resources remain and a state of fatigue in which passive behavior reigns is more likely. Some research appears to support this notion. For instance, Patall et al. (2008) found that instructionally irrelevant choices were more effective, and hypothesized two possible reasons for the finding: because (a) less effort was required than for meaningful choices (which supports ego depletion), or (b) participants desired expressing their individuality. However, the intervention methods utilized in ego depletion studies may be incomparable to studies positing SDT (Moller, Deci, & Ryan, 2006). These studies (e.g., Bruyneel, Dewitte, Vohs, & Warlop, 2006; Muraven & Baumeister, 2000) investigated subsequent task persistence on activities unrelated to the choice while studies examining choice within the SDT framework investigated the task for which the choice was made (Patall et al., 2008). Moreover, Moller et al. (2006) examined the ego depletion model under different conditions and found that an authentic, autonomous choice did not drain resources, while coerced choice was depleting.

In another example, Reeve et al. (2003) found that perceived choice did not predict self-determination or experienced intrinsic motivation, although an internal locus of control and perceived volition did. However, their manipulation of choice involved predetermined options—the choice was proffered within controlled parameters and was similar to choices in previous studies that reported negative results (Reeve et al., 2003). In prior investigations that reported a positive relationship between intrinsic motivation and choice, volition and an internal locus were also nurtured through the choice (Reeve et al., 2003). Thus, they proposed that choice should be

offered in a context that nurtures an internal causality orientation and volition. In this way, choice should only be *part* of the experience, not the entire experience.

It is generally acknowledged that multiple variables and distinctions among the choices studied can influence student outcomes, ranging from type of choice, number of choices, environment, implicit messages, interactions with control groups, and research design; thus, generalizing results is fraught with conflict (e.g., Moller et al., 2006; Patall et al., 2008; Patall et al., 2008; Patall et al., 2013). Universally controlling all variables in a statistically similar manner is challenging, if not impossible, to achieve and, as such, research has not yet determined the manner of choice most effective.

One can have many options and not feel autonomy, but instead feel overwhelmed and resentful at the effort entailed in the decision making. Alternatively, one could have only one option (which functionally means no choice) and yet feel quite autonomous so long as one truly endorses that option. Furthermore, choice can, when meaningful, facilitate self-determination, especially when it allows one to find that which one can wholeheartedly endorse. But choice can be constructed to do nothing of the sort, instead engendering confusion or fatigue. (Ryan & Deci, 2006, p. 1577)

In this way and others, the study of choice varies greatly between publications and, in turn, it is difficult to determine if choice should generally be considered a negative, positive, or neutral influence on motivation and motivation-related outcomes. It is likely that one should approach provision of choice carefully when intending to facilitate perceived autonomy.

Redefining choice within the self-determination framework. Because SDT relies heavily on the concept of choice, some have endorsed redefining its connection to choice. Deci and Ryan (1985) described self-determination as “the capacity to choose and to have those

choices, rather than reinforcement contingencies, drives, or any other forces or pressures, be the determinants of one's actions" (p. 38). When self-determined, choices are made within a flexible context and without apparent coercion. Reeve et al. (2003) suggested that the concept of choice is broader than this supposition and that its role in self-determination requires clarification and attention to *action* choice. They recommended an updated definition that stresses an internal locus and volition, rather than the act of choosing:

Self-determination is the capacity to determine one's actions as they emerge from an internally locused and volitional causality, rather than from an externally locused causality . . . or from an internally locused but nonvolitional causality. . . . When self-determined, one acts out of an internally locused, volitional causality based on an awareness of one's organismic needs and a flexible interpretation of external events.

(Reeve et al., 2003, p. 388)

The "choice" was removed and, instead, the autonomy supports present in the environment encourage perceptions of a volitional "choice over options and actions . . . less likely to be presented as a choice over options only" (Reeve et al., 2003, p. 389).

Conversely, Patall et al. (2010) argued that perceived choice influences and enriches students' perceptions of multiple conditions of an autonomy supportive motivating style. Whatever the direction, if any, research indicates that multiple autonomy supportive conditions presented in tandem support self-determination (e.g., Patall et al., 2013), while single factors presented individually are generally less beneficial (e.g., Deci et al., 1994).

Practical Educational Implications

In their meta-analysis, Patall et al. (2008) found that effects varied depending on the manipulation of choice and the methods used to present choices. For instance, (a) in line with

previous research (e.g., Deci et al., 2001), external rewards for choices negatively affected outcomes; (b) inconsistent with theory, instructionally irrelevant (i.e., superficial) choices had the greatest positive effect on intrinsic motivation in comparison to instructionally relevant (i.e., meaningful) choices; (c) choosing one option from lists in succession had more positive effects than making one or more selections from only one list of options on one instance; (d) the most favorable number of options to provide was three to five rather than too few (i.e., one or two) or too many (i.e., greater than five) options; (e) when control group participants were aware of choices made by intervention groups that were not likewise offered or were knowingly deprived of a choice, the effect of the manipulation was greatest between groups; and (f) when participants were coerced in some way or led towards more attractive options significantly negative implications results when compared to other, less controlled, study designs (Patall et al., 2008). These findings demonstrate that there are multiple factors to attend when providing choice. In the next sections, I describe additional practical implications, including (1) relationships between competence and choice, and (2) the concept of an action choice.

Competence and choice. It seems that the implications of choice provision likely depend on the individual, as findings have varied depending on the manner and type of choice (e.g., Patall et al., 2008; Reeve et al., 2003), as well as the characteristics of the individuals making choices (e.g., Iyengar & Lepper, 1999). Some have argued that individuals must both make and act on choices, which involves two elements: (a) ability, which requires knowledge of options from which to choose and the necessary skill or competence for accomplishing or acting on the selected task; and (b) willingness, which involves motivation for choosing and the confidence to act on the selected option (Boud, 1981; Littlewood, 1996). Although learners begin dependent on others, as skill and confidence develop, they move toward autonomous learning (Boud, 1981).

On these points, researchers have specifically examined the relationship between perceived competence and choice.

In their lab-based study, Patall et al. (2014) found that motivation was positively associated with provision of choice when participants engaged in a word game on which they initially believed they would be successful, and the reverse was evident when initial competence was low. Similarly, in their theoretical framework, Lawless and Brown (1997) addressed learner control in multimedia environments and the varied results, which reported both the positive and negative impact of learner control. In most of the reviewed studies, learner control manifested as navigational choices selected from a preformed list of options. They found that students who had the least background knowledge or competence were positioned to gain the least from learner control, and further, that total autonomy was indeed detrimental to achievement due to cognitive overload (Lawless & Brown, 1997). Katz and Assor (2007) also reviewed literature concerning the motivating and demotivating aspects of choice, and similarly postulated that choice can be motivating when competence is supported in that choices are not too cognitively or psychologically tasking. Others have specifically described a relationship between competence and task selection. Meyer, Folkes, and Weiner (1976) found that when choice of task difficulty level was offered, people tended to choose an intermediate level. Further, their positive perceptions and task performance peaked when realizing those tasks. However, when potentially competence-thwarting feedback was expected after task completion, those with low competence beliefs elected to choose easier tasks (Meyer et al., 1976), demonstrating how perceived competence experienced after a task can impact future tasks.

Action choice. An action choice is a volitional decision to choose to act or not, which can communicate an internal locus of control and volition (Reeve et al., 2003). When teachers offer

action choices, they should also support students in acknowledging and understanding their needs as well as broadly supporting their autonomy (Reeve et al., 2003). Reeve et al. (2003) examined students' perceptions when provided "option choices" (i.e., choice over several options; e.g., choice of puzzle) vs. "action choices" (i.e., a combination of action and option choices; e.g., choice of puzzle, choice of timeframe, and choice to continue working) and found that action choices were more positively associated with perceived volition. An action choice may also be a fully volitional decision to make no choice or take no action. On this point, Botti, Orfali, and Iyengar (2009) examined autonomy in tragic circumstances (e.g., removal of life support). They found that when making extremely emotionally laden, tragic decisions, relinquishing control of decision-making was associated with significantly less negative affect. Participants who were faced with tragic decisions experienced a weakened desire for autonomy; however, when the decision was made externally, they also reported some bitterness with surrendering control. Studying less emotional circumstances, Botti and Iyengar (2004) investigated satisfaction with decisions and found decreased satisfaction in those who had choice in comparison to those with no choice when the context of the choice was undesirable, and increased satisfaction when the context of the choice was desirable. Indeed, making an undesirable choice predicted even lower satisfaction than experienced by individuals without any opportunity for choice. These studies demonstrate that making an undesired decision can have negative consequences, supporting the concept of an action choice.

Table 2 includes practical applications of choice based on the research and theory described in this section. Overall, students' perceptions of choice depend on the specific characteristics of each event and learning environment. One implication of this review is the importance of communicating an internal locus of causality and volition when offering choice (Reeve et al., 2003), as well as ensuring the nutrient of all three psychological needs (Katz &

Assor, 2007). Simply offering a choice may be insufficient. Instead, teachers have much to consider, such as characteristics of choice supported by evidence (e.g., number of options; see Table 2), the student's perceived competence and ability to carry out the selected option, tone and manner of communicating the choice opportunity, the superficial or meaningful nature of the choice, students' preferences for choosing or not, and whether students perceive that they can choose to act or not.

Table 2

Summary of Beneficial and Detrimental Practices in Providing Choice

Beneficial conditions	Detrimental conditions
<ul style="list-style-type: none"> • Offer instructionally irrelevant/superficial choices • Offer meaningful choices • Offer one option from lists in succession (rather than one or more selections from only one list of options on one instance) • Offer three to five options • Communicate freedom and volition with choice opportunities • Offer action choices • Support competence when providing choice and align choices with students' capabilities • Support inner resources (autonomy, competence, relatedness) in contexts in which choices are offered • Align choices with values and goals • Offer a reasonable number of decision-making opportunities 	<ul style="list-style-type: none"> • Providing external rewards for choices • Awareness of choices made by others that are not likewise offered • Awareness of being deprived of a choice • Coercion when choices are made/selected • Leading individuals toward more attractive options • Providing highly controlled choices • Providing too many choices • Providing too many options from which to choose • Offering choices in which students are not confident in, or lack skills necessary, in following through with (cognitive overload) • Forcing an undesired choice

Note. This table includes a summary of selected practical applications of choice per those studies and theories discussed in the Choice section of this paper.

Recommendations and Future Directions

The purpose of this article was to explain autonomy-related constructs and some teaching implications associated those perspectives. We conclude by presenting a few recommendations for practitioners and researchers. First, we recommend that practitioners both maintain important classroom structures (e.g., provide clear procedures, behavioral expectations, performance expectations, and feedback) and nurture their students' needs for autonomy (Jang, Reeve, & Deci, 2010). A classroom should not be a place of disorder in which students are permitted to behave as they will in hopes that they feel autonomous (Jones, 2009). Second, we propose that instructors view the elements of an autonomy supportive style as interactive in nature. Research suggests that the conditions of an autonomy supportive interpersonal style are most effective when they are not isolated, indicating the pervasiveness of multiple forms of motivation support in an autonomy-supportive environment (Deci et al., 1994; Patall et al., 2013; Reeve et al., 2003). In fact, in Su and Reeve's (2011) meta-analysis, 84% of the studies incorporated at least four conditions of autonomy support into intervention designs. The objective is likely not to assiduously support perceived autonomy; the key appears to be supporting many motivational resources to help students become motivated, autonomous, and self-directed learners who perform well, value learning, and function positively overall. Rather than viewing these resources as targeting autonomy more narrowly, it may be beneficial to consider that these motivational resources support one another, reciprocally. Our recommendation is that teachers should endeavor to actively facilitate multiple motivation resources. Conceptual frameworks like the MUSIC Model of Academic Motivation may be useful resources when instructors are targeting students' motivation on multiple dimensions (Jones, 2009; Jones, in press).

Similarly, as Deci and Ryan (2012) stated, “Although autonomy is clearly a central issue in both individual and collective development and wellness, it is nonetheless a complex construct, manifest in different ways” (p. 85). Thus, our first recommendation for researchers is that they continue to examine autonomy as a complex construct that can impact motivation in a multifaceted fashion, and to consider the potential for dynamic relationships with other motivation constructs. In fact, there have been several calls for more integrated views of academic motivation, underscoring this point (e.g., Jones, 2009; Kaplan, Katz, & Flum, 2012, 2014; Turner et al., 2014). For example, a different approach to data analysis, often named a *person* or *person-centered* approach, provides researchers with the opportunity to investigate the complexities of individuals’ perceptions (e.g., multivariate and patterns-based approaches like cluster analysis; Bergman, 2001; Kaplan et al., 2012). In a person-centered approach, motivation constructs are studied as dynamic, interactionistic processes, emphasizing a holistic view of the individual as central, rather than the variable (Bergman, 2001). Methods like these may be particularly useful when investigating motivation constructs and, in particular, the need for autonomy. Our second recommendation is to clearly define autonomy and be specific about how the term is being used and measured. Moreover, it is important not to confuse the terms “autonomy” and “autonomy support,” as autonomy support includes interpersonal behaviors that can support autonomy but also support a variety of motivation resources (Reeve, 2009). Finally, our third recommendation is for researchers to attend to and report multiple contextual variables when manipulating choice (e.g., type of choice, language used), as it appears that any number of factors can affect the perceived functional significance of each choice. Complex systems are relevant when a choice is proffered, which affect how the choice is received. Only by recording and reporting such information can we begin to unravel the intricacies of provision of choice in influencing motivation-related beliefs.

References

- Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261-271. doi:10.1037/0022-0663.84.3.261
- Assor, A., Kaplan, H., & Roth, G. (2002). Choice is good, but relevance is excellent: Autonomy-enhancing and suppressing teacher behaviours predicting students' engagement in schoolwork. *British Journal of Educational Psychology, 72*(2), 261-278. doi:10.1348/000709902158883
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A. (1999). Social cognitive theory: An agentic perspective. *Asian Journal of Social Psychology, 2*(1), 21-41. doi:10.1111/1467-839X.00024
- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego-depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology, 74*, 1252-1265. doi:10.1037/0022-3514.74.5.1252
- Baumeister, R., & Leary, M. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*(3), 497-529. doi:10.1037/0033-2909.117.3.497
- Bergin, C., & Bergin, D. (2009). Attachment in the classroom. *Educational Psychology Review, 21*, 141-170. doi:10.1007/s10648-009-9104-0
- Bergman, L. R. (2001). A person approach in research on adolescence: Some methodological challenges. *Journal of Adolescent Research, 16*, 28-53. doi:10.1177/0743558401161004

- Botti, S., & Iyengar, S. S. (2004). The psychological pleasure and pain of choosing: When people prefer choosing at the cost of subsequent outcome satisfaction. *Journal of Personality and Social Psychology*, 87(3), 312-326. doi:10.1037/0022-3514.87.3.312
- Botti, S., Orfali, K., & Iyengar, S. S. (2009). Tragic choices: Autonomy and emotional responses to medical decisions. *Journal of Consumer Research*. 36(3), 337-352. doi:10.1086/598969
- Boud, D. (Ed.). (1981). *Developing student autonomy*. New York, NY: Nichols.
- Chirkov, V., Ryan, R. M., Kim, Y., & Kaplan, U. (2003). Differentiating autonomy from individualism and independence: A self-determination theory perspective on internalization of cultural orientations and well-being. *Journal of Personality and Social Psychology*, 84(1), 97-110. doi:10.1037/0022-3514.84.1.97
- Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology*, 88(4), 715-730. doi:10.1037/0022-0663.88.4.715
- Covington, M. V. (1992). *Making the grade: A self-worth perspective on motivation and school reform*. New York, NY: Cambridge University Press.
- Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York, NY: Harper & Row.
- deCharms, R. (1968). *Personal causation: The internal affective determinants of behavior*. New York, NY: Academic Press.
- deCharms, R. (1976). *Enhancing motivation: Change in the classroom*. New York, NY: Irvington.

deCharms, R. (1977). Students need not be pawns. *Theory into Practice*, 16(4), 296-301.

doi:10.1080/00405847709542716

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*, 18(1), 105-115. doi:10.1037/h0030644

Deci, E. L., Betley, G., Kahle, J., Abrams, L., & Porac, J. (1981). When trying to win: Competition and intrinsic motivation. *Personality and Social Psychology Bulletin*, 7(1), 79-83. doi:10.1177/014616728171012

Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality*, 62(1), 119-142.

doi:10.1111/j.1467-6494.1994.tb00797.x

Deci, E. L., Koestner, R., & Ryan, R. M. (2001). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125(6), 627-668. doi:10.1037/0033-2909.125.6.627

Deci, E. L., & Moller, A. C. (2005). The concept of competence: A starting place for understanding intrinsic motivation and self-determined extrinsic motivation. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 570-597). New York, NY: Guilford.

Deci, E. L., Nezlek, J., & Sheinman, L. (1981). Characteristics of the rewarder and intrinsic motivation of the rewardee. *Journal of Personality and Social Psychology*, 40(1), 1-10.

doi:10.1037/0022-3514.40.1.1

Deci, E. L., & Ryan, R. M. (1980). The empirical exploration of intrinsic motivational processes. *Advances in Experimental Social Psychology*, 13, 39-80. doi:8080/10.1016/S0065-2601(08)60130-6

- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum Press.
- Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology*, 53(6), 1024-1037. doi:10.1037/0022-3514.53.6.1024
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227-268. doi:10.1207/S15327965PLI1104_01
- Deci, E. L., & Ryan, R. M. (2012). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 85-107). New York, NY: Oxford University Press.
- Deci, E. L., Schwartz, A. J., Sheinman, L., & Ryan, R. M. (1981). An instrument to assess adults' orientations toward control versus autonomy with children: Reflections on intrinsic motivation and perceived competence. *Journal of Educational Psychology*, 73(5), 642-650. doi:10.1037/0022-0663.73.5.642
- Dweck, C. S. (1999). *Self-theories: Their role in motivation, personality, and development*. Philadelphia, PA: Psychology Press.
- Elliot, A. J., & Dweck, C. S. (2005). Competence and motivation: Competence as the core of achievement motivation. In A. J. Elliot, & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 3-12). New York, NY: Guilford.
- Flowerday, T., & Schraw, G. (2003). Effect of choice on cognitive and affective engagement. *Journal of Educational Research*, 96(4), 207-215. doi:10.1080/00220670309598810

Gentry, M., Rizza, M. G., & Owen, S. V. (2013). Examining perceptions of challenge and choice in classrooms: The relationship between teachers and their students and comparisons between gifted students and other students. *Gifted Child Quarterly*, 46(2), 145-155.

doi:10.1177/001698620204600207

Goldstein, K. (1939). *The organism*. New York, NY: American Book.

Grolnick, W. S., & Ryan, R. M. (1987). Autonomy in children's learning: An experimental and individual difference investigation. *Journal of Personality and Social Psychology*, 52(5), 890-898. doi:10.1037/0022-3514.52.5.890

Grolnick, W. S., & Ryan, R. M. (1989). Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology*, 81(2), 143-154. doi:10.1037/0022-0663.81.2.143

Hagger, M. S., & Chatzisarantis, N. L. D. (2011). Causality orientations moderate the undermining effect of rewards on intrinsic motivation. *Journal of Experimental Social Psychology*, 47, 485-489. doi:10.1016/j.jesp.2010.10.010

Hardre, P. L., & Reeve, J. (2003). Training corporate managers to adopt a more autonomy-supportive motivating style toward employees: an intervention study. *International Journal of Training and Development*, 13(3), 165-184. doi:10.1111/j.1468-2419.2009.00325.x

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, 41(2), 111-127. doi:10.1207/s15326985ep4102_4

Iyengar, S. S., & Lepper, M. R. (1999). Rethinking the value of choice: A cultural perspective on intrinsic motivation. *Journal of Personality and Social Psychology*, 76(3), 349-366. doi:10.1037/0022-3514.76.3.349

- Iyengar, S. S., & Lepper, M. R. (2000). When choice is demotivating: Can one desire too much of a good thing? *Journal of Personality and Social Psychology*, 79(6), 995-1006. doi:10.1037/0022-3514.79.6.995
- Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology*, 102(3), 588-600. doi:10.1037/a0019682
- Jones, B. D. (2009). Motivating students to engage in learning: The MUSIC model of academic motivation. *International Journal of Teaching and Learning in Higher Education*, 21(2), 272-285. Retrieved from <http://www.isetl.org/ijtlhe/pdf/IJTLHE774.pdf>
- Jones, B. D. (in press). Teaching motivation strategies using the MUSIC model of motivation as a conceptual framework. In M. C. Smith & N. DeFrates-Densch (Eds.), *Challenges and innovations in educational psychology teaching and learning*.
- Jones, B. D., & Skaggs, G. (2012, August). *Validation of the MUSIC Model of Academic Motivation Inventory: A measure of students' motivation in college courses*. Research presented at the International Conference on Motivation 2012, Frankfurt, Germany.
- Jones, B. D., & Wilkins, J. L. M. (2013a). Testing the MUSIC Model of Academic Motivation through confirmatory factor analysis. *Educational Psychology*, 33(4), 482-503. doi:10.1080/01443410.2013.785044
- Jones, B. D., & Wilkins, J. L. M. (2013b, May). *Validity evidence for the use of a motivation inventory with middle school students*. Poster presented at the annual meeting of the Society for the Study of Motivation, Washington, DC.
- Jones, B. D., & Wilkins, J. (2015, February). *More validity evidence for the use of the MUSIC Model of Academic Motivation Inventory with upper-elementary and middle school*

students. Poster presented at the annual meeting of the Eastern Educational Research Association, Sarasota, Florida.

Kaplan, A., Katz, I., & Flum, H. (2012). Motivation theory in educational practice: Knowledge claims, challenges, and future directions. In K. R. Harris, S. G. Graham, & T. Urdan (Eds.), *APA educational psychology handbook: Individual differences, cultural considerations, and contextual factors in educational psychology* (Vol. 2, pp. 165-194). Washington, DC: American Psychological Association.

Kaplan, A., Katz, I., & Flum, H. (2014, April). Practice-relevant motivational research: Do we need a different approach? In L. Corno (Chair), *Practice-relevant motivational research: Do we need a different approach?* Symposium conducted at the annual meeting of the American Educational Research Association, Philadelphia, PA.

Kasser, V., & Ryan, R. M. (1999). The relation of psychological needs for autonomy and relatedness to vitality, well-being, and mortality in a nursing home. *Journal of Applied Social Psychology, 29*, 935-454.

Katz, I., & Assor, A. (2007). When choice motivates and when it does not. *Educational Psychology Review, 19*(4), 429-442. doi:10.1007/s10648-006-9027-y

Koestner, R., Ryan, R. M., Bernieri, F., & Holt, K. (1984). Setting limits in children's behavior: The differential effects of controlling vs. informational styles on intrinsic motivation and creativity. *Journal of Personality, 52*(3), 233-248. doi:10.1111/j.1467-6494.1984.tb00879.x

Könings, K. D., Brand-Gruwel, S., & Elen, J. (2012). Effects of a school reform on longitudinal stability of students' preferences with regard to education. *British Journal of Educational Psychology, 82*, 512-532. doi:10.1111/j.2044-8279.2011.02044.x

- Lawless, K., & Brown, S. (1997). Multimedia learning environments: Issues of learner control and navigation. *Instructional Science*, 25, 117-131.
- Lewin, K. (1951). Intention, will, and need. In D. Rapaport (Ed.), *Organization and pathology of thought* (pp. 95-153). New York, NY: Columbia University Press. doi:10.1037/10584-005
- Lin, C.-L., Liang, J.-C., Su, Y.-C., & Tsai, C.-C. (2013). Exploring the relationships between self-efficacy and preference for teacher authority among computer science majors. *Journal of Educational Computing Research*, 49(2), 189-207. doi:10.2190/EC.49.2.d
- Linnenbrink-Garcia, L., Patall, E. A., & Messersmith, E. E. (2013). Antecedents and consequences of situational interest. *British Journal of Educational Psychology*, 83, 591-614. doi:10.1111/j.2044-8279.2012.02080.x
- Littlewood, W. (1996). "Autonomy": An anatomy and a framework. *System*, 24(4), 427-435. doi:10.1016/S0346-251X(96)00039-5
- Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review*, 98(2), 224-253. doi:10.1037/0033-295X.98.2.224
- Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, 50(4), 370-396. doi:10.1037/h0054346
- Miller, R. B., & Brickman, S. J. (2004). A model of future-oriented motivation and self-regulation. *Educational Psychology Review*, 16(1), 9-33. doi:10.1023/B:EDPR.0000012343.96370.39
- Milyavskaya, M., & Koestner, R. (2011). Psychological needs, motivation, and well-being: A test of self-determination theory across multiple domains. *Personality and Individual Differences*, 50(3), 387-391. doi:8080/10.1016/j.paid.2010.10.029

- Moller, A. C., Deci, E. L., & Ryan, R. M. (2006). Choice and ego depletion: The moderating role of autonomy. *Personality and Social Psychology Bulletin*, 32, 1024-1036.
doi:10.1177/0146167206288008
- Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin*, 126(2), 247-259.
doi:10.1037/0033-2909.126.2.247
- Noddings, M. (1992). *The challenge to care in schools: An alternative approach to education*. New York, NY: Teachers College Press.
- Patall, E. A. (2012). The motivational complexity of choosing: A review of theory and research. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 248-279). New York, NY: Oxford University Press.
- Patall, E. A., Cooper, H., & Robinson, J. C. (2008). The effects of choice on intrinsic motivation and related outcomes: A meta-analysis of research findings. *Psychological Bulletin*, 134(2), 270-300. doi:10.1037/0033-2909.134.2.270
- Patall, E. A., Cooper, H., & Wynn, S. R. (2010). The effectiveness and relative importance of choice in the classroom. *Journal of Educational Psychology*, 102(4), 896-915.
doi:10.1037/a0019545
- Patall, E. A., Dent, A. L., Oyer, M., & Wynn, S. R. (2013). Student autonomy and course value: The unique and cumulative roles of various teacher practices. *Motivation and Emotion*, 37(1), 14-32. doi:10.1007/s11031-012-9305-6
- Patall, E. A., Sylvester, B. J., & Han, C.-W. (2014). The role of competence in the effects of choice on motivation. *Journal of Experimental Social Psychology*, 50(1), 27-44.
doi:10.1016/j.jesp.2013.09.002

- Reber, R., Hetland, H., Chen, W., Norman, E., & Kobbeltvedt, T. (2009). Effects of example choice on interest, control, and learning. *Journal of the Learning Sciences*, 18(4), 509-548. doi:10.1080/10508400903191896
- Reeve, J. (2006). Teachers as facilitators: What autonomy-supportive teachers do and why their students benefit. *Elementary School Journal*, 106(3), 225-236. doi:10.1086/501484
- Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist*, 44(3), 159-175. doi:10.1080/00461520903028990
- Reeve, J., & Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *Journal of Educational Psychology*, 98(1), 209-218. doi:10.1037/0022-0663.98.1.209
- Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and Emotion*, 28(2), 147-169. doi:10.1023/B:MOEM.0000032312.95499.6f
- Reeve, J., & Nix, G. (1997). Expressing intrinsic motivation through acts of exploration and facial displays of interest. *Motivation and Emotion*, 21(3), 237-250. doi:10.1023/A:1024470213500
- Reeve, J., Nix, G., & Hamm, D. (2003). Testing models of the experience of self-determination in intrinsic motivation and the conundrum of choice. *Journal of Educational Psychology*, 95(2), 375-392. doi:10.1037/0022-0663.95.2.375
- Reis, H. T., Sheldon, K. M., Gable, S. L., Roscoe, J., & Ryan, R. M. (2000). Daily well-being: The role of autonomy, competence, and relatedness. *Personality and Social Psychology Bulletin*, 26, 419-435. doi:10.1177/0146167200266002

- Rice, T., & Hanoch, Y. (2008). Can consumers have too much choice? *Expert Reviews of Pharmacoconomics Outcomes Research*, 8(4), 325-327.
- Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality*, 63(3), 397-427. doi:10.1111/j.1467-6494.1995.tb00501.x
- Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, 57(5), 749-761. doi:10.1037/0022-3514.57.5.749
- Ryan, R. M., & Deci, E. L. (2006). Self-regulation and the problem of human autonomy: Does psychology need choice, self-determination, and will? *Journal of Personality*, 74(6), 1557-1586. doi:10.1111/j.1467-6494.2006.00420.x
- Ryan, R. M., & Grolnick, W. S. (1986). Origins and pawns in the classroom: Self-report and projective assessments of individual differences in children's perceptions. *Journal of Personality and Social Psychology*, 50(3), 550-558. doi:10.1037/0022-3514.50.3.550
- Ryan, R. M., & Weinstein, N. (2009). Undermining quality teaching ad learning: A self-determination theory perspective on high stakes testing. *Theory and Research in Education*, 7(2), 224-233. doi:10.1177/1477878509104327
- Schraw, G., Flowerday, T., & Reisetter, M. F. (1998). The role of choice in reader engagement. *Journal of Educational Psychology*, 90(4), 705-714. doi:10.1037/0022-0663.90.4.705
- Schwartz, B. (2000). Self-determination: The tyranny of freedom. *American Psychologist*, 55(1), 79-88. doi:10.1037//0003-066X.55.1.79
- Schwartz, B., Ward, A., Monterosso, J., Lyubomirsky, S., White, K., Lehman, D. R. (2002). Maximizing versus satisficing: Happiness is a matter of choice. *Journal of Personality and Social Psychology*, 83(5), 1178-1197. doi:10.1037/0022-3514.83.5.1178

- Seltsam, K. (1931). Organismic psychology and educational theory. *Journal of Educational Psychology*, 22(5), 351-359. doi:10.1037/h0072881
- Sheldon, K. M., Ryan, R. M., & Reis, H. T. (1996). What makes for a good day? Competence and autonomy in the day and in the person. *Personality and Social Psychology Bulletin*, 22(12), 1270-1279. doi:10.1177/01461672962212007
- Skinner, B. F. (1971). *Beyond freedom and dignity*. Indianapolis, IN: Hackett.
- Stefanou, C. R., Perencevich, K. C., DiCintio, M., & Turner, J. C. (2004). Supporting autonomy in the classroom: Ways teachers encourage student decision making and ownership. *Educational Psychologist*, 39(2), 97-110. doi:10.1207/s15326985ep3902_2
- Su, Y.-L., & Reeve, J. (2011). A meta-analysis of the effectiveness of intervention programs designed to support autonomy. *Educational Psychology Review*, 23(1), 159-188. doi:10.1007/s10648-010-9142-7
- Sweller, J., & Chandler, P. (1994). Why some material is difficult to learn. *Cognition and Instruction*, 12(3), 185-233. doi:10.1207/s1532690xci1203_1
- Tai, R. H., Sadler, P. M., & Maltese, A. V. (2007). A study of the association of autonomy and achievement on performance. *Science Educator*, 16(1), 22-28.
- Turner, J. C., Christensen, A., Kackar-Cam, H. Z., Trucano, M., & Fulmer, S. M. (2014). Enhancing students' engagement: Report of a 3-year intervention with middle school teachers. *American Educational Research Journal*, 51(6), 1195-1226. doi:10.3102/0002831214532515
- Turner, J. C., & Meyer, D. K. (2000). Studying and understanding the instructional contexts of classrooms: Using our past to forge our future. *Educational Psychologist*, 35(2), 69-85. doi:10.1207/S15326985EP3502_2

- Vallerand, R. J., Fortier, M. S., & Guay, F. (1997). Self-determination and persistence in a real-life setting: Toward a motivational model of high school dropout. *Journal of Personality and Social Psychology*, 72(5), 1161-1176. doi:10.1037/0022-3514.72.5.1161
- Vansteenkiste, M., Lens, W., & Deci, E. L. (2006). Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. *Educational Psychologist*, 41(1), 19-31. doi:10.1207/s15326985ep4101_4
- Vansteenkiste, M., Sierens, El., Soenens, B., Luyckx, K., & Lens, W. (2009). Motivational profiles from a self-determination perspective: The quality of motivation matters. *Journal of Educational Psychology*, 101(3), 671-688. doi:10.1037/a0015083
- Wang, M.-T., & Eccles, J. S. (2013). School context, achievement motivation, and academic engagement: A longitudinal study of school engagement using a multidimensional perspective. *Learning and Instruction*, 28, 12-23. doi:10.1016/j.learninstruc.2013.04.002
- White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review*, 66(5), 297-333. doi:10.1037/h0040934
- Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, 25(1), 68-81. doi:10.1006/ceps.1999.1015
- Williams, S. (1998). An organizational model of choice: A theoretical analysis differentiating choice, personal control, and self-determination. *Genetic, Social & General Psychology Monographs*, 124, 465-492.
- Williams, G. C., Cox, E. M., Kouides, R., & Deci, E. L. (1999). Presenting the facts about smoking to adolescents: Effects of an autonomy-supportive style. *Archives of Pediatrics and Adolescent Medicine*, 153(9), 959-964. doi:10.1001/archpedi.153.9.959

- Williams, G. C., & Deci, E. L. (1996). Internalization of biopsychosocial values by medical students: A test of self-determination theory. *Journal of Personality and Social Psychology*, 70(4), 767-779. doi:10.1037/0022-3514.70.4.767
- Wolfson, B. J., & Nash, S. (1968). Perceptions of decision-making in elementary-school classrooms. *Elementary School Journal*, 69(2), 89-93. doi:10.1086/460483
- Woodworth, R. S. (1918). *Dynamic psychology*. New York, NY: Columbia University Press.

Chapter 3: Identifying Motivation Profiles of Students in Science Class

Abstract

The present study followed a person-centered approach, cluster analysis, which focused on developing a multidimensional perspective of motivation to examine whether profiles could be identified for upper-elementary and middle school students in relation to their motivation beliefs about their science class; thus, this study serves as a proof of concept. We collected data from 937 completed questionnaires and measured students' perceptions of the need for autonomy, utility value, expectancy for success, interest, and caring in science class. Furthermore, we investigated the relationship of motivation profiles to important outcomes, such as students' motivational beliefs about science, effort in science class, science grades, and science goals. 5 clusters (i.e., "motivation profiles") emerged: the (1) low motivation profile; (2) low value and high support profile; (3) moderate motivation profile; (4) moderate empowerment and values, and high support profile; and (5) high motivation profile. Cluster stability was tested by cluster analyzing subsamples (year, grade level), and relationships between the clusters and correlated variables provided some evidence of predictive validity. Then, each motivation profile is described. Our hope is that these findings support science educators in targeting students with similar motivation profiles rather than adhering to the difficult and often unrealistic task of catering to each student's complex needs, individually. Finally, because cluster analysis is not as widely used in educational research as many other methods, an ancillary focus of this paper was to describe our analysis procedures for other researchers.

Finding well-educated and trained professionals to fill science, technology, engineering, and mathematics (STEM) positions is a national concern in the US (Smith, 2012) in part because research and funding in STEM fields is integral to US prosperity (National Academy of Sciences [NAS], 2007). Providing educational experiences that support students' success in science and mathematics is critical to ensuring that they are adequately prepared for STEM professions (NAS, 2007; President's Council of Advisors on Science and Technology [PCAST], 2012; Smith, 2012). Unfortunately, students are increasingly entering college underprepared for and uninterested in pursuing STEM fields (Osborne, 2003; PCAST, 2012). One factor important for students' long-term persistence in STEM is nurturing their motivation and interest in science prior to eighth grade (Maltese & Tai, 2010; PCAST, 2012; Tai et al., 2006). Although interest in science tends to wane with age (Osborne, 2003; Simpson & Oliver, 1990), teaching methods and school culture can positively affect science persistence and motivation, which often declines in less supportive environments (Fortus & Vedder-Weiss, 2014; Vedder-Weiss & Fortus, 2010). However, little is known about the instructional factors that affect upper elementary and middle school students' motivation and interest in science over time.

Although variable-centered approaches to data analysis have been effective at identifying trends in students' interests and motivational beliefs in science over time (Osborne, 2003; Simpson & Oliver, 1990; Simpkins, Davis-Kean, & Eccles, 2006), these approaches do not allow teachers to understand how students' motivational beliefs interact with one another in their classes to motivate students. Variable-centered approaches investigate the effects of isolated variables linearly, rather than "motivational phenomena as continuously emerging systems of dynamically interrelated components" (Kaplan, Katz, & Flum, 2014, para. 4) that are multidimensional, complex, and context-bound (Turner & Meyer, 2000). A different approach to data analysis, often named a

person-centered or *person* approach (e.g., cluster analysis), allows researchers to focus on the complex nature of the individual and motivation constructs are studied as dynamic, interactionistic processes (Bergman, 2001; Kaplan, Katz, & Flum, 2012). Hence, in person-centered approaches, the variable is not central; rather, the person is central because the dynamic interplay of multiple variables is studied by investigating patterns and relationships among them (Bergman, 2001). Consequently, in cluster analysis, for example, researchers can examine a more integrated profile of the individual in which those with similar patterns of relationships among variables are organized into a cluster (Bergman, 2001; Wormington, Corpus, & Anderson, 2012).

The results of cluster analysis may be used to help educators target students with similar “motivation profiles,” rather than adhere to the difficult and often unrealistic task of catering to each student’s individual complex needs. Moreover, it may be possible to identify profiles of students who are more or less likely to pursue science-related majors or careers. Using profiles, teachers could more intentionally target students’ motivation in science classrooms and increase the likelihood that more students will engage in science, either by choosing a science-related career or by becoming a more scientifically-literate member of society. Several recent studies have used cluster analysis to examine students’ profiles at the school or academic level (e.g., Hayenga & Corpus, 2010; Meece & Holt, 1993; Ratelle, Guay, Vallerand, Larose, & Senécal, 2007; Schwinger, Steinmayr, & Spinath, 2012; Tuominen-Soini, Salmela-Aro, Niemivirta, 2011; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009; Wormington et al., 2012), at the domain level (e.g., Chen, 2012; Conley, 2012; Hartwell & Kaplan, 2014; Turner, Thorpe, & Meyer, 1998), or at the class level (e.g., Daniels et al., 2008; Shell & Husman, 2008; Shell & Soh, 2013). However, no studies have focused on upper-elementary and middle school students in science classes.

In this study, we used a person-centered approach and a multidimensional perspective of motivation to examine whether profiles could be identified for upper-elementary and middle school students in relation to their motivation beliefs about their science class. Furthermore, we investigated the relationship of these profiles to important outcomes, such as students' motivational beliefs about science, effort in science class, science grades, and science goals. Overall, this study serves as a proof of concept: Are there theoretically meaningful motivation profiles in the studied population? If motivation profiles of students in science class can be identified and the profiles are related to important outcomes, then it may be possible to more effectively design teaching strategies within science classes to foster students' motivational beliefs and career goals.

Constructs Selected for the Person-Centered Analysis

To develop profiles of students' motivational beliefs in science classes, we selected five motivation-related constructs that have been studied over several decades and have been shown to be associated with students' motivational beliefs and important academic outcomes: autonomy (e.g., Deci & Ryan, 1991), utility value (e.g., Eccles et al., 1983), expectancy for success (Bandura, 1986; Eccles et al., 1983), interest (e.g., Hidi & Renninger, 2006), and caring (e.g., Deci & Ryan, 2000; Noddings, 1992). These five constructs are consistent with the teaching strategies related to students' motivation and engagement in the MUSIC Model of Academic Motivation (Jones, 2009), and similar constructs have been used in recent studies to investigate students' engagement (e.g., Turner, Christensen, Kackar-Cam, Trucano, & Fulmer, 2014; Wang & Eccles, 2013). In this section, we briefly explain our rationale for including these constructs and, in the following sections, we provide more evidence to support our assertions.

First, because the primary purpose of identifying motivational profiles was to allow for the potential to design appropriate teaching strategies, it was critical that the profiles included

constructs that are malleable in an instructional context. That is, we wanted to be able to translate the constructs into plausible instructional strategies. Therefore, we included only constructs that had been shown to be changeable by an instructor in the learning environment (e.g., Reeve, Jang, Carrell, Jeon, & Barch, 2004; Turner et al., 2014; Wang & Eccles, 2013).

Second, we included constructs that were well established in the literature as having significant impacts on educational outcomes. The five constructs we selected have been shown to be related to several important outcomes, including engagement and motivation (Wang & Eccles, 2013; Wigfield & Eccles, 2000), interest and domain identification (Jones, Ruff, & Osborne, in press; Osborne & Jones, 2011), and career goals (Jones, Osborne, Paretti, & Matusovich, 2014).

Third, we did not want to be limited to the constructs within any one theory because we wanted to investigate academic motivation as a complex, multidimensional, dynamic, and context-bound phenomenon, which likely would involve constructs from several theories of motivation. The five constructs we selected are supported by many different theories, including self-determination theory (Deci & Ryan, 2000), expectancy-value theory (Eccles et al., 1983), social cognitive theory (Bandura, 1986), interest theories (Hidi & Renninger, 2006), belongingness (Baumeister & Leary, 1995), self-concept theory (Marsh, 1990), self-efficacy theory (Bandura, 1986), self-worth theory (Covington, 1992), and goal orientation theory (Ames, 1992), among others.

Fourth, we wanted parsimonious profiles with as few constructs as possible, yet enough that would allow us to explain an adequate amount of variance in educational outcomes. Therefore, we did not want to include constructs that overlapped significantly in definition (e.g., self-efficacy and expectancy for success; intrinsic interest value and intrinsic motivation). The five constructs we selected have been shown to be distinct in samples of upper elementary and

middle grades students (Eccles & Wigfield, 1995; Jones & Wilkins, 2013b, 2015) and college students (Jones & Skaggs, 2012; Jones & Wilkins, 2013a).

Fifth, we wanted to include constructs that were measurable with instruments that were practical to administer and valid for use with upper elementary and middle school students. The five constructs we selected have been measured with self-report Likert-type items, which can be administered to an entire class quickly and inexpensively (Jones & Wilkins, 2013b, 2015).

Conceptual Framework

We employed a multidimensional perspective of motivation that included science class perceptions and motivational beliefs. Our conceptual model presented in Figure 4 shows that students' class perceptions affect, and are affected by, their motivational beliefs. The class perceptions and motivational beliefs then affect, and are affected by, outcomes such as science class effort and grades. The relationships shown in Figure 4 are consistent with expectancy-value theory (Eccles et al., 1983), domain identification theory (Osborne & Jones, 2011), and social cognitive theory (Bandura, 1986), among others. Recently, Wang and Eccles (2013) provided empirical evidence for many of the relationships shown in Figure 4, including that students' perceptions of their school environment predicted outcomes such as engagement in school.

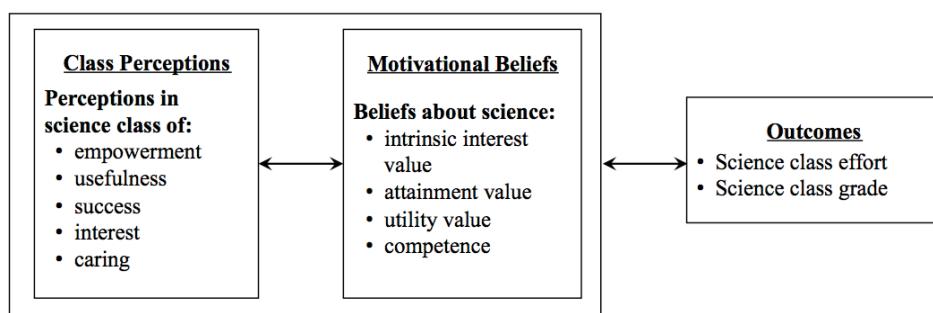


Figure 4. Conceptual model. Adapted from "Motivation and the MUSIC Model" by B. D. Jones, 2014, unpublished manuscript, Virginia Tech, Blacksburg, VA. Copyright 2014 by Brett D. Jones. Used with permission of Brett D. Jones.

Class Perceptions

In our conceptual model, students' class perceptions included five well-established motivational constructs: need for autonomy, utility value, expectancy for success, interest, and caring. These five constructs align with the five components of the MUSIC Model of Academic Motivation (Jones, 2009): eMpowerment, Usefulness, Success, Interest, and Caring, with the capitalized letters forming the acronym "MUSIC." The five key principles of the MUSIC model are that students are more motivated when they perceive that they are *empowered*, they perceive that the content or activities are *useful*, they believe that they can be *successful*, they are *interested* in the topic or activities, and they feel *cared* for by others in the learning environment. Based on an extensive examination of the motivation research, the MUSIC model was designed to organize instructional strategies to assist teachers in understanding and applying theory and research in motivation to their instructional design and practices (Jones, 2009). Thus, a primary objective of the MUSIC model is to organize current motivation research and theory into a framework that classroom instructors can easily understand and apply in a practical manner. The terminology used in the model was selected not to create new motivation constructs but, instead, to be more recognizable and understandable to educators than the jargon used by motivation researchers (e.g., utility value, self-efficacy). By aligning the constructs used in our study to the instructional strategy framework of the MUSIC model, we were able to ensure that any profiles identified in our study could be associated with practical, research-based instructional strategies. In this section, we explain each of the five MUSIC model components and their associated constructs.

Empowerment. The empowerment component of the MUSIC model refers to teaching strategies that provide students with the opportunity to become autonomous learners by encouraging perceptions of choice, freedom, and volition (Jones, 2009). By empowering students,

instructors can meet students' need for autonomy, which "encompasses people's strivings to be agentic, to feel like the 'origin' (deCharms, 1968) of their actions, and to have a voice or input in determining their own behavior" (Deci & Ryan, 1991, p. 243). Empowering students can meet one of their basic psychological needs (the need for autonomy) and is consistent with self-determination theory (Deci & Ryan, 2000). Students who feel autonomous tend to be more intrinsically motivated and engaged in their learning (Deci & Ryan, 2000; Wang & Eccles, 2013).

It is important to note that the empowerment component of the MUSIC model is not synonymous with the "autonomy support" construct (Jones & Skaggs, 2012). Autonomy support includes aspects of the empowerment construct, but it is more broadly defined than empowerment. Definitions of autonomy support typically include most of the following five elements: providing meaningful rationales, acknowledging negative feelings, using non-controlling language, offering choices, and nurturing inner motivational resources (for a review, see Su & Reeve, 2011). For example, *nurturing inner motivational resources* can include constructs such as interest, intrinsic motivation, competence, relatedness, sense of challenge, and intrinsic goals (Su & Reeve, 2011), whereas these constructs are more closely aligned with other components of the MUSIC model as we explain in the following sections.

Teachers can empower students by giving them some control over their learning environment by offering meaningful choices (e.g., choices of topics and team members); offering opportunities for students to make decisions in the learning environment (e.g., lesson pace); and in welcoming students' opinions (Jones, 2009). In addition, it is important to communicate that students have an action choice or the ability to decide to be autonomous or to fully endorse relinquishing control to another (Reeve, Nix, & Hamm, 2003).

Usefulness. The usefulness component of the MUSIC model includes instructional strategies that allow students to perceive that their coursework (e.g., assignments, activities, readings) is useful for their short- or long-term goals (Jones, 2009). The usefulness component is consistent with constructs such as utility value (Eccles et al., 1983; Eccles & Wigfield, 1995; Wigfield & Eccles, 2000). As explained by Wigfield and Eccles (2000), “Utility value or usefulness refers to how a task fits into an individual’s future plans” (p. 72). Perceptions that learning tasks are useful or instrumental in achieving academic and personal goals can positively affect motivation (Simons, Vansteenkiste, Lens, & Lacante, 2004), persistence (De Volder & Lens, 1982; Miller, Greene, Montalvo, Ravindran, & Nichols, 1996; Simons et al., 2004), engagement (Greene, Miller, Crowson, Duke, & Akey, 2004; Miller et al., 1996; Simons et al., 2004), effort (De Volder & Lens, 1982; Miller et al., 1996; Simons et al., 2004), and intention to study in a specific field (Jones, Paretti, Hein, & Knott, 2010). To support students’ perceptions of usefulness in an educational environment, instructors can connect content, routines, and strategies to the real world through rationales and by defining real-life implications; design tasks and activities that relate to students’ long-term, intrinsic goals; implement experiential, hands-on learning; and incorporate personally relevant topics (Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Jones, 2009).

Success. The success component of the MUSIC model includes teaching strategies that foster students’ perceptions that they can succeed if they put forth the appropriate effort (Jones, 2009). This component is consistent with constructs such as expectancy for success (Eccles et al., 1983; Eccles & Wigfield, 1995; Wigfield & Eccles, 2000), competence motivation (Elliot & Dweck, 2005; White, 1959), and self-efficacy (Bandura, 1986). In self-determination theory, competence is a basic psychological need that is necessary for healthy psychological growth, functioning, and well-being, and that it is vital for intrinsic motivation (Deci & Ryan, 2000). Elliot

and Dweck (2005) also explained that “competence can be seen as a basic psychological need that has a pervasive impact on daily affect, cognition, and behavior across age and culture” (p. 8).

Students can meet their need for competence through successful interactions in their learning environment. Self-efficacy theory (Bandura, 1986), which addresses one’s perceptions and judgments of one’s ability to perform or function in particular domains, has been found to predict students’ motivation to choose, engage in, and persist in academic tasks (Bandura, 1986, 1997; Bong & Skaalvik, 2003; Schunk & Pajares, 2005; Zimmerman & Schunk, 2003). This construct is malleable such that one’s self-efficacy can be determined by one’s experiences; thus, student self-efficacy and, in turn, academic motivation, is susceptible to teacher influence (Zimmerman & Schunk, 2003). In addition, students’ self-theories about intellectual abilities can influence outcomes like motivation, resilience, persistence, and performance (Yeager & Dweck, 2012).

When students believe that intelligence is malleable, they are more likely to believe that hard work and effort will render positive results. Conversely, static beliefs (e.g., “I’m just not a math person”) can lead to poor motivation and performance (Yeager & Dweck, 2012).

Teachers can support students’ success perceptions in a variety of ways, such as by providing attainably challenging tasks and learning goals; clear and realistic expectations; meaningful, timely, and constructive feedback that can be implemented and is applicable to future learning; opportunities for success if students put forth effort; and opportunities to practice and master concepts (Jones, 2009). Teachers can also foster malleable beliefs about intelligence, teach lessons considering novice vs. expert understandings, and break difficult tasks into attainable chunks to nurture positive ability perceptions (Jones, 2009).

Interest. The interest component of the MUSIC model pertains to instructional strategies that stimulate interest in the academic activity, content, or domain (Jones, 2009). Interest is

“liking and willful engagement in a cognitive activity” (Schraw & Lehman, 2001, p. 23); therefore, it includes both an affective component of positive emotion and a cognitive component of concentration (Hidi & Renninger, 2006). Students’ interests can progress along a continuum in which triggered “situational” interest (which is short-term and context-specific) can lead to well-developed “individual” interest (which is more enduring than situational interest; Hidi & Renninger, 2006). As Hidi and Renninger (2006) explained: “Situational interest refers to focused attention and the affective reaction that is triggered in the moment by environmental stimuli, which may or may not last over time” (p. 113). Because the intent of the present study was to investigate students’ perceptions of their current science class, we focused on their situational interest rather than their longer-term individual interest. Our rationale was that, regardless of students’ level of individual interest in science, instructors can strive to design instruction that is situationally interesting to students. Situational interest is consistent with constructs such as intrinsic motivation (Deci, 1975), intrinsic interest value (Eccles & Wigfield, 1995), and flow (Csikszentmihalyi, 1990). Interest can influence a variety of factors, including engagement, attention, persistence, goals, strategy use, enjoyment, and performance (Hidi & Harackiewicz, 2000; Hidi & Renninger 2006; Schraw & Lehman, 2001). Although it may only last a brief period, situational interest is a necessary condition for the development of individual interest (Hidi & Renninger, 2006). Thus, if teachers can trigger students’ situational interest, development of individual interest is possible. Teachers can stimulate students’ interest in many ways, such as by inciting curiosity and/or strong emotions, introducing novelty, using a variety of instructional tools and/or tasks, including social interaction, connecting content to background knowledge and prior experiences, and using humor (Bergin, 1999; Jones, 2009).

Caring. Included in the caring component of the MUSIC model are instructional strategies aimed at creating a learning environment in which students feel that their instructors and classmates care about their learning and general well-being (Jones, 2009). As Noddings (1992) explained: “A *caring relation* is in its most basic form, a connection or encounter between two human beings—a carer and a recipient of care, or cared-for” (p. 15). The carer (the one providing the caring) must be in a state of consciousness that is characterized by “open, nonselective receptivity to the cared-for” (p. 15); he must “really hear, see, or feel what the other tries to convey” (p. 16). Additionally, the cared-for must receive the caring and show that it has been received.

The caring component is consistent with constructs such as caring (Noddings, 1984, 1992), belongingness (Baumeister & Leary, 1995), relatedness (Deci & Ryan, 2000), and attachment (Ainsworth, 1973, 1979; Bowlby, 1969; for educational implications, see Bergin & Bergin, 2009). Caring is closely related to the relatedness construct in self-determination theory, in which feelings of relatedness are integral to sustaining intrinsic motivation and are considered a basic psychological need necessary for well-being and positive psychological functioning (Deci & Ryan, 2000). Belongingness also involves “a pervasive drive to form and maintain at least a minimum quantity of lasting, positive, and significant interpersonal relationships” (Baumeister & Leary, 1995, p. 497), which can include interactions with others in general, rather than specifically the instructor. Positive interactions with instructors and peers can positively influence motivation-related outcomes (e.g., Wentzel, 1997, 2002; Wentzel, Battle, Russell, & Looney, 2010). Furthermore, when students have healthy, secure attachments with teachers, parents, and peers, they are more likely to experience an increase in academic performance, academic motivation, emotional development, and social skill development (Bergin & Bergin, 2009).

Instructors can encourage positive perceptions of caring and feelings of belonging through their classroom interactions (Jones, 2009). In Wentzel's (1997) study, students described caring instructors as those who emphasized a democratic style, attended to the individuality of students, provided positive and meaningful feedback, and went the "extra mile" in teaching and planning. Caring can also be nurtured by supporting students' educational goals; demonstrating care and concern for achieving learning objectives, personal goals, and well-being; providing opportunities for positive interactions with peers; carefully designing instruction to encourage student learning; and making oneself available for academic support after hours (Jones, 2009).

Summary. The components of the MUSIC model align with existing motivation constructs, it does not create new constructs. Rather, the emphasis in the MUSIC model is translating the constructs into principles that teachers can follow when designing instruction. Research suggests that educators can positively influence students' motivation, engagement, and other motivation-related outcomes by purposefully targeting positive experiences of empowerment, usefulness, success, interest, and caring through their pedagogical practices.

Motivational Beliefs

To assess students' motivational beliefs, we selected constructs from expectancy-value theory because they have a well-established empirical and theoretical background (e.g., Eccles et al., 1983, Eccles & Wigfield, 1995; Wigfield & Eccles, 2000). According to expectancy-value theory, motivational beliefs (i.e., expectancy/competence beliefs, interest value, attainment value, and utility value) affect students' choices, effort, persistence, and achievement (Eccles et al., 1983; Simpkins et al., 2006; Wigfield & Eccles, 1992, 2000). Although expectancy for success and competence-related beliefs were initially conceptualized as separate constructs (Eccles et al., 1983), factor analyses on samples of middle and high school students

demonstrated that students' expectancies and competence-related perceptions were not empirically distinct (Eccles & Wigfield, 1995; Eccles, Wigfield, Harold, & Blumenfeld, 1993). Consequently, Eccles and Wigfield (1995) combined both constructs into one expectancy/ability perceptions factor. Factor analysis has also shown that task values can be divided into at least three factors: interest value, attainment value, and utility value (Eccles & Wigfield, 1995). Interest value is defined as the enjoyment experienced from participating in an activity or an individual's interest in a domain, attainment value is the importance of doing well on a task, and utility value is the usefulness of a task in terms of one's future goals (Eccles, 2005).

Research Questions

We investigated the science class perceptions and motivation beliefs of fifth-, sixth-, and seventh-grade students to address the following research questions. RQ1: Can students' science class perceptions be used to categorize students into groups with similar motivation profiles? RQ2: If different student motivation profiles can be identified, do the profiles relate to other important motivational beliefs and academic outcomes? We expected that, at the minimum, a high motivation profile and a low motivation profile would emerge. Our hypothesized "high" motivation profile would indicate high evidence of the five MUSIC model components' presence in science class. The "low" motivation profile would suggest low averages for each MUSIC component, indicating that students perceived that those components were fairly absent in their science classes. We hypothesized that the students in the high motivation profile would have higher motivational beliefs than students in low motivation profile. We did not hypothesize further about the profiles to maintain the exploratory nature of this investigation and to avoid preconceptions that could influence our analysis.

We chose to study upper-level elementary and middle school students in science classes for several reasons. First, the NAS (2007) cited a need for improved science content literacy and science instruction in elementary and middle level teachers, as early intervention is often the best intervention and it is important to target science students early on in their educational careers (Osborne, 2003; PCAST, 2010, 2012; Maltese & Tai, 2010; Tai et al., 2006). Understanding these students' motivational beliefs is important to understanding how to better motivate this population and improve the quality of science education. Second, motivation for science often decreases during and after the middle grades, and negative and lasting perceptions about science can manifest early on (Osborne, 2003; PCAST, 2010; Simpson & Oliver, 1990). Reaching students just prior to transitioning to the middle grades and during the middle grades may be helpful in understanding this trend of negative perceptions. Finally, Tai et al. (2006) posited that the eighth grade is important because eighth-grade students who are interested in STEM fields are more likely to choose to study a STEM field in the future. In turn, nurturing an interest in the years just prior to eighth-grade is critical (PCAST, 2010; Tai et al., 2006).

Methodology

Participants

The participants were students in grades five, six, and seven from two rural public schools in Southwest Virginia. We collected data at three time-points and received responses from 326 students in 2012 (84% of all students in those grades at the schools), 320 students in 2013 (87% of all possible students), and 291 students in 2014 (76% of all possible students). This sample included a total of 937 completed questionnaires (some students completed a questionnaire for two or three years), with 398 completed questionnaires (178 students) representing students assessed at multiple time points and 539 students assessed only once. Hereafter, we refer to each completed

questionnaire as one “case.” The majority (90.7%) of the students identified as White and the others identified as Black or African American, (1.7%), Hispanic (1.2%), Asian or Pacific Islander (1.2%), American Indian (2.6%), or “other” (2.7%), and two students chose not to answer. Slightly over half of the students who reported their sex (52.5%) were female. According to state guidelines, both schools were considered to comprise a high proportion of low-income students and qualified for federal Title I funds (Virginia Department of Education [VDOE], 2012; VDOE Office of School Nutrition Programs, 2014). Both schools were well represented with each contributing approximately half of the cases (47.7% and 52.3%).

Procedures

In May of 2012, 2013, and 2014, all fifth-, sixth-, and seventh-grade students present at two K-7 schools in the same county completed a questionnaire related to their perceptions about science. Students had been enrolled in their science classes since the beginning of school year and the questionnaires were administered near the end of each school year. The schools had seven science teachers in the three grade levels, with one at each grade level (except for fifth-grade at one school, which added a second science teacher in 2014). We obtained Institutional Review Board approval prior to conducting the study.

Measures

The questionnaire was titled generically as a “Science Questionnaire” and was part of a larger study that examined students’ motivation-related perceptions about their current science class, their motivation beliefs about science, and their demographic information. Unless noted otherwise, the items were scaled using a 6-point Likert-type format with the following descriptors: 1 = *strongly disagree*, 2 = *disagree*, 3 = *mostly disagree*, 4 = *mostly agree*, 5 = *agree*, and 6 = *strongly agree*. The measures we used in this study are provided in the Appendix.

Class perceptions. The MUSIC Model of Academic Motivation Inventory (MMAMI; Jones, 2012) was designed to examine students' motivation-related perceptions in higher-education courses. For this study, we used the 18-item version of the MMAMI that has been validated for use with fifth-, sixth-, and seventh-grade students in science classes (Jones, 2012; Jones & Wilkins, 2013b, 2015). The MMAMI measures students' perceptions of the five components of the MUSIC model: empowerment/need for autonomy, usefulness/utility value, success/expectancy for success, interest, and caring.

Table 3 shows what each MUSIC model component scale measures and the related construct. Convergent and discriminant validity evidence obtained through factor analysis suggested that the 18 items loaded adequately with the five-factor MUSIC model (Jones & Wilkins, 2013b, 2015). Cronbach's alphas for this measure have been shown to be acceptable for upper-elementary and middle grades students in science (empowerment $\alpha = .70, .72$; usefulness $\alpha = .82, .80$; success $\alpha = .79, .84$; interest $\alpha = .78, .77$; caring $\alpha = .78, .85$; Jones & Wilkins, 2013b).

Table 3

The MUSIC Model Components, Definitions, and Related Constructs

MUSIC Component	Definitions	Related constructs
Empowerment	The degree to which a student perceives that: he or she has control of his or her learning environment	need for autonomy
Usefulness	the class work is useful to his or her future	utility value
Success	he or she can succeed at the class work	expectancy for success
Interest	the instructional methods and class work are interesting or enjoyable	situational interest
Caring	the teacher cares about whether the student succeeds in the class work and cares about the student's well-being	caring

Motivational beliefs. The measure of students' science competence beliefs (i.e., self-concept, ability perceptions) included three items used often by Eccles and her colleagues and that have been shown to have excellent face, convergent, and discriminant validity (e.g., Eccles & Wigfield, 1995; Simpkins et al., 2006) and acceptable Cronbach's alpha values ($\alpha = .86$ in Simpkins et al., 2006 for a measure with two of the three items; $\alpha = .86$ in Eccles & Wigfield, 1995, for a measure that includes these three items in a five-item scale). Each item has a different 6-point scale: "How good at science are you?" (1 = *not at all good*, 6 = *very good*); "If you were to list all of the students in your class from worst to best in science, where would you put yourself? (1 = *one of the worst*, 6 = *one of the best*); "How have you been doing in science this year?" (1 = *very poorly*, 6 = *very well*). We measured science interest value with two items similar to the two items used by Simpkins et al. (2006) and the same as those used by Jones, Wilkins, Long, and Wang (2012; $\alpha = .91$) to measure intrinsic interest value, which was defined similar to Eccles et al. (1983) and Eccles and Wigfield (1995), as "the subjective interest an individual has in a subject and the enjoyment experienced from performing an activity" (Jones et al., 2012, p. 7). We used a three-item measure of utility value that was used by Hulleman et al. (2008; $\alpha = .72$) to measure the extent to which students perceived a class to be useful to their life and future. Because attainment value and domain identification are conceptually similar (Eccles, 2005; Jones et al., 2010), we measured attainment value using a four-item measure of domain identification based on a "Devaluing" scale (Schmader, Major, & Gramzow, 2001) that was modified by Jones et al. (2010) to measure engineering identification (i.e., the extent to which individuals value a domain as a central part of their self). Cronbach's alphas for this measure have been shown to be acceptable for engineering identification ($\alpha = .84$ and $.89$ in Jones et al., 2010), mathematics identification ($\alpha = .85$ in Lesko & Corpus, 2006), and academic devaluing ($\alpha = .78$ in Schmader et al., 2001).

Outcomes. We measured science effort with a four-item measure based on the Effort/Importance scale that is part of the Intrinsic Motivation Inventory (Plant & Ryan, 1985). This scale measures the amount of perceived effort that students put forth in a course. Cronbach's alpha values have been shown to be acceptable ($\alpha = .84, .84, .86$, and $.84$ in Jones, 2010). We used one item to measure students' self-reported estimated science grades: "What is your BEST estimate as to your current grade in your science class this year?" Students responded by selecting a letter grade from a list of 10 options: A+, A, A-, B+, B, B-, C+, C, C-, and "below C." This item serves as an estimated measure of performance in science class and was treated as a continuous variable during subsequent analysis, with $10 = A+$, $9 = A$, $8 = A-$, $7 = B+$. . . $1 = \text{below } C$. Researchers have found that self-reported grades are often positively correlated with actual grades (Kuncel, Credé, & Thomas, 2005; Svanum & Bigatti, 2006) and several studies of motivation using cluster analysis included similar measures (e.g., Daniels et al., 2008; Shell & Husman, 2008; Vansteenkiste et al., 2009; Wormington et al., 2012).

Analysis

Using SPSS version 22 software, we followed a two-step clustering procedure recommended by Bacher, Wenzig, and Vogler (2004) and used in several recent studies (e.g., Hartwell & Kaplan, 2014; Huberty, Jordan, & Brandt, 2005; Vansteenkiste et al., 2009; Wormington et al., 2012): (1) hierarchical agglomerative analysis (following Ward's method) followed by (2) k -means analysis. This process includes both hierarchical and non-hierarchical methods to find the most appropriate cluster fit, in which the second analysis serves to more effectively demarcate clusters developed in the first (Bacher et al., 2004). We first ran a hierarchical analysis to determine the optimal number of clusters and preliminary *cluster centers*

(i.e., means for each MUSIC model variable in each cluster; Burns & Burns, 2008) and then k -means analysis for validation and to obtain the final cluster centers (Mooi & Sarstedt, 2011).

Hierarchical agglomerative cluster analysis is a process through which clusters or groups form when individual cases (i.e., a single student's five-dimensional response, which includes one value for each of the five MUSIC components) are amalgamated at each step of the analysis until, at the final step, all cases combine into one large cluster (Bartholomew et al., 2008; Kaufman & Rousseeuw, 1990). The researcher can then determine at which stage the most appropriate number of clusters formed. During the analysis, cases with similar responses are amalgamated. Initially, each case represents a single-case cluster, which generally form the initial cluster centers. Then, at each step, every case or cluster is compared to other cases or clusters, and pairings are selected that represent the least amount of lost information (i.e., the least sum of squares, or differences from the overall cluster center; Bartholomew et al., 2008). Ward's method reduces variance within clusters by computing squared Euclidean distances, which sums the squared differences across every variable in the analysis during each stage (Norušis, 2011). By minimizing the distance measures from each case and the cluster center, cases that combine into the same cluster are more similar than those assigned to other clusters. When cases are amalgamated in this way, the foremost consideration is (the inevitable) loss of information; the focus is to minimize difference/dissimilarity measures to develop fairly homogeneous groups (Bartholomew et al., 2000; Norušis, 2011). Before computing Ward's procedure, we sorted the existing data randomly. Hierarchical analysis can be sensitive to order because the analysis begins at one case and systematically assesses difference between each point such that the order of the points can affect the initial cluster centers and how clusters begin forming (Norušis, 2011).

To select the optimum number of clusters (i.e., a stopping point in the cluster analysis) for our cluster solution and maximize internal validity (Bacher, 2002), we examined the fusion coefficients provided in an agglomeration schedule (an SPSS output) for measures of change as clusters merged. When a large decrease in the coefficient is notable between two steps, clusters merged that cause a substantial change in overall within-cluster dissimilarity. Smaller change coefficients between subsequent steps indicate that those clusters bear similar heterogeneity; thus, merging clusters during those stages “adds much less to distinguishing between cases” (Burns & Burns, 2008, p. 560). We designated the stopping point (i.e., the *cluster solution*, or number of clusters) when cluster coefficients indicated a large change such that later steps became markedly more similar (Burns & Burns, 2008, p. 561; Norušis, 2011). When multiple cluster solutions appeared suitable, we examined each solution’s cluster centers and selected the solution representative of the most parsimonious and theoretically meaningful model (Bacher, 2002; e.g., Shell & Soh, 2013; Turner et al., 1998; Vansteenkiste et al., 2009). Finally, we tested other potentially viable solutions to determine whether they rendered more appropriate, meaningful solutions (e.g., Shell & Soh, 2013), analyzing the relative validity of the cluster solutions (Bacher, 2002).

A limitation of hierarchical analysis is that, once a case has been assigned a particular cluster, it cannot be unassigned (Asendorpf et al., 2001; Kaufman & Rosseeuw, 1990). In other words, cases cannot move to different, perhaps more appropriate clusters later during the analysis as the clusters take shape and deviate naturally from the initial formation. Hence, it is important to complete an additional clustering method using the cluster solution determined with Ward’s method (Norušis, 2011). With this limitation in mind, we computed *k*-means cluster analysis as a secondary test, which is considered a validation procedure (Mooi & Sarstedt, 2011) and test of stability (Bacher, 2002). *K*-means cluster analysis involves selecting a predetermined

number of clusters (k)—we used the number of clusters defined by Ward’s method—to “fine tune” the cluster centers (Bacher et al., 2004; Huberty et al., 2005; e.g., Wormington et al., 2012). The k -means procedure is used as a secondary test because hierarchical analysis is needed initially to determine the optimal number of clusters, which serves as k . Unlike hierarchical cluster analysis, k -means clustering allows cases to flow through multiple iterations such that cases can change their cluster assignment as the analysis matures; thus, the resulting cluster centers are more reliable and accurate. Iterations begin with a set of cluster centers whereby cases are classified per their distance to that centroid (Norušis, 2011). Then, each cluster center from the previous step is recomputed. Next, cases are assigned again to cluster centers based on the new averages and the aforementioned steps are repeated until there is little change in the cluster centers between steps (Norušis, 2011). The final iteration ends with each case assigned to a permanent cluster and the final cluster centers are computed (Norušis, 2011). To assess the reliability of the clusters, we compared the hierarchical and k -means cluster solutions using Cohen’s kappa (κ ; Reilly, Wang, & Rutherford, 2005), with a value considered acceptable at .60 or higher (e.g., Asendorpf et al., 2001; Vansteenkiste et al., 2009).

We validated our cluster solution in several ways. First, we ran the same analyses with multiple subsets of the population, including analyzing the data from multiple years and grade levels. In addition, we re-computed several cluster analyses with cases sorted randomly to assess stability (Bacher, 2002). Then, we used a formal double-split cross-validation procedure in which we split the subsample into two random halves, recomputed the two-step clustering procedure followed by a nearest neighbor analysis as a reliability measure (Breckenridge, 2000). Then, we compared the nearest neighbor solution to the two-step clustering solution using Cohen’s κ , with $\kappa \geq .60$ considered acceptable fit (Breckenridge, 2000; e.g., Wormington et al., 2012). To verify that

the clusters were statistically different (Mooi & Sarstedt, 2011) and produce more evidence for the internal validity (Bacher 2002), we examined one-way ANOVAs with the five clustered variables as the dependent variables and cluster membership as the factor.

To determine appropriate cluster typology while preserving the multivariate properties of the analysis, we computed a discriminant function analysis (Burns & Burns, 2008; e.g., Gabel, 1992; Jung, Owusu-Antwi, & An, 2006; Weissman & Magill, 2008). Discriminant analysis is a multivariate method that distinguishes between groups based on several variables (Galbraith & Jiaqing, 1999) and can be used to characterize, or profile, clusters (Jung et al., 2006). In essence, the variables that contributed most in distinguishing between groups are highlighted (Hale & Glassman, 1986). We included the cluster membership as the dependent variable and averages of each MUSIC model component as the independent variables. In the present study, discriminant analysis served in a descriptive function only; its common utility as a function of probability was irrelevant (Fraley & Raftery, 2002; e.g., Weissman & Magill, 2008).

Finally, to examine RQ2, we tested the predictive validity of the clustering solution by running several one-way ANOVAs with theoretically correlated outcomes, including science interest value, science utility value, science attainment value, science competence beliefs, science class effort, and science class grade estimate.

Results

Table 4 includes correlations among all tested variables. We presented the results from only the 2014 dataset, as the correlations were consistent across all three years. Grade level did not correlate strongly with any class perceptions or motivational beliefs, although there was a general pattern that students at the higher grades reported lower motivation-related perceptions than students at the lower grades, consistent with previous research findings (e.g., Wigfield,

Eccles, Schiefele, Roeser, & Davis-Kean, 2006). All of the correlations between class perceptions, motivational beliefs, and outcome variables were positive and statistically significant, and most of them were moderate to strong. These correlations are consistent with theory and previous research (e.g., Eccles & Wigfield, 1995; Jones, Osborne, Paretti, & Matusovich, 2014; Jones & Skaggs, 2012; Wang & Eccles, 2013).

Table 4

Correlations and Descriptive Statistics, 2014 Sample

	1	2	3	4	5	6	7	8	9	10	11	12
1. Grade level	—	-.00	-.18**	.00	-.07	-.18**	-.10	-.13*	-.12*	-.12	-.14*	-.23**
2. Grade est.		—	.37**	.67**	.29**	.39**	.23**	.22**	.11**	.47**	.27**	.33**
3. Effort			—	.59**	.65**	.80**	.59**	.52**	.57**	.69**	.67**	.51**
4. Competent				—	.49**	.58**	.42**	.34**	.33**	.57**	.47**	.39**
5. Interest val.					—	.63**	.70**	.43**	.54**	.54**	.67**	.33**
6. Attain. value						—	.66**	.52**	.57**	.67**	.63**	.47**
7. Utility value							—	.52**	.77**	.52**	.65**	.32**
8. Empwmnt.								—	.58**	.48**	.61**	.38**
9. Usefulness									—	.46**	.70**	.28**
10. Success										—	.61**	.64**
11. Interest											—	.44**
12. Caring												—
<i>M</i>	5.95	7.48	4.74	4.66	4.13	4.53	4.03	4.17	4.14	4.85	4.26	5.12
<i>SD</i>	.88	2.33	1.07	1.00	1.35	1.11	1.31	1.16	1.33	1.15	1.27	.97

Note. Grade est. = estimated science grade; Competent = competence beliefs in science; Interest val. = science interest value; Attain. value = science attainment value; Empwmnt. = empowerment. For grade level, each level corresponds with the appropriate numeral (e.g., 5 = fifth). All other variables scored on a 6-point scale. $N = 284$ (Grade estimate $N = 271$).

* < 0.05 .

** < 0.01 .

Cluster Analyses

The first step of our analysis involved removing univariate and multivariate outliers. We removed cases with one or more variable means 3 standard deviations above or below each overall variable mean (Vijendra & Shivani, 2014), which included 18 (1.9%) univariate outliers. Next, we ran initial k -means cluster analyses to identify and remove cases that formed any extremely small clusters (i.e., clusters with very few cases; Chawla & Gionis, 2013; Jiang, Tseng, & Su, 2001; Kaufman & Rousseeuw, 1990), which accounted for three multivariate outliers. We utilized this procedure because k -means clustering is especially sensitive to outliers, often forming small N clusters using outlier cases as cluster centers (Norušis, 2011; Kaufman & Rousseeuw, 1990). In all, we removed 21 outliers (2.2%), which left us with a total sample of 916 cases.

A limitation of cluster analysis is that the method may not produce any meaningful or repeatable solutions, as clustering is primarily an exploratory method and can heavily depend on the structure of the sample (Bartholomew et al., 2008; Lange, Roth, Braun, & Buhmann, 2004). A cluster solution is considered more robust and stable when it is repeated under different circumstances (e.g., different clustering algorithms, re-ordered cases, diverse samples or subsamples; Bacher, 2002; Lange et al., 2004; Norušis, 2011). Cluster-analyzing subsamples characterized by specific variables (e.g., grade level, year) can test whether those variables influence the cluster solutions (Bacher, 2002). Accordingly, we computed multiple cluster analyses in two main stages to explore the profiles and examine their stability across subsamples. First, we conducted two-step cluster analyses for cases at each year point (2012, 2013, 2014) in three separate two-step analyses, which were our primary cluster analyses. Second, to test the stability of the cluster solutions obtained in the first stage (Bacher, 2002), we computed the two-step clustering procedure (a) for cases at each grade level (fifth, sixth, and seventh) across the

three years in three separate two-step analyses, and (b) with all 916 cases in one two-step analysis. The final test of all 916 cases included single students' responses from more than one time-point (i.e., some students were considered more than one case); however, students responded to questions concerning only their current science class and science teacher, which allowed us to use each response as one case. We conducted the final test only to confirm stability of the motivation profiles already identified in earlier procedures.

In cluster analysis, at least two observations for each variable (2:1) with a minimum of 200 observations is considered an acceptable ratio (Egan, 1984). Because we had 916 observations and five variables (916:5), our sample of 916 cases was more than adequate. In addition, our sample sizes for the year analyses (2012 $n = 324$, 2013 $n = 308$, 2014 $n = 284$) and grade level analyses (fifth $n = 325$, sixth $n = 264$, seventh $n = 327$) were also adequate. Similar cluster analyses in academic motivation literature included comparable sample sizes (e.g., Vansteenkiste et al., 2009; Hartwell & Kaplan, 2014; Shell & Soh, 2013; with sample sizes of 291 and 484 [two analyses], 139, and 233, respectively).

Stage 1: Clusters per year. We selected a five-cluster solution as the best description of the data for the three hierarchical analyses at each year point (2012, 2013, 2014) based on our consideration of the fusion coefficients (e.g., see Table 5, an agglomeration schedule for the 2014 analysis) and our theoretical interpretation. We reached this solution for each year independently. Furthermore, the cluster centers aligned between years, as shown in Table 6 and Figure 5.

We also tested three-, four-, and six-cluster solutions and determined that they did not provide more meaningful or interpretable solutions. The four-cluster solution combined cases from Clusters 2 and 4 from the five-cluster solution. The five-cluster solution added meaning by parsing out those students whose perceived usefulness and interest were either somewhat more

negative (Cluster 2) or positive (Cluster 4) and assigned them to separate clusters. The six-cluster solution was not theoretically interpretable and was not supported by the fusion coefficients. The three-cluster solution, though parsimonious, did not adequately describe the data, providing only “high,” “middle,” and “low” clusters in which the nuances of student motivation were lost.

Table 5

Proximity Matrix of Agglomeration Schedule, 2012

No. of clusters	Agglomeration last step	Coefficient this step	Change
2	2456.438	1443.295	1013.143
3	1443.295	1259.228	184.067
4	1259.228	1077.905	181.323
5	1077.905	947.331	130.574
6	947.331	858.008	89.323
7	858.008	801.628	56.380
8	801.628	761.292	40.336
9	761.292	724.997	36.295
10	724.997	689.109	35.888

Note. The **bold** font indicates two options for selecting a stopping point where the change coefficient suggests more substantial difference coefficients between steps.

Table 6

Five-Cluster Solution: Comparisons Among Years

	Year	Cluster				
		1 Low	2 Low value and high support	3 Somewhat high	4 Somewhat high empowerment and values, high support	5 High
eEmpowerment	2012	2.7 ^{sl}	4.0 ^{sh}	4.0 ^{sh}	3.8 ^{sh}	5.4 ^h
	2013	2.6 ^{sl}	4.2 ^{sh}	4.0 ^{sh}	4.1 ^{sh}	5.1 ^h
	2014	2.3 ^l	3.3 ^{sl}	4.0 ^{sh}	4.0 ^{sh}	5.1 ^h
Usefulness	2012	2.4 ^l	2.5 ^{sl}	4.1 ^{sh}	4.4 ^{sh}	5.5 ^{vh}
	2013	2.3 ^l	2.5 ^{sl}	3.7 ^{sh}	4.3 ^{sh}	5.5 ^{vh}
	2014	2.4 ^l	2.4 ^l	4.0 ^{sh}	3.8 ^{sh}	5.4 ^h
Success	2012	3.0 ^{sl}	4.6 ^h	4.0 ^{sh}	5.2 ^h	5.7 ^{vh}
	2013	3.4 ^{sl}	4.9 ^h	4.1 ^{sh}	5.2 ^h	5.6 ^{vh}
	2014	2.5 ^{sl}	4.6 ^h	3.9 ^{sh}	5.3 ^h	5.6 ^{vh}
Interest	2012	2.0 ^l	3.2 ^{sl}	3.6 ^{sh}	4.5 ^h	5.4 ^h
	2013	2.4 ^l	3.0 ^{sl}	4.0 ^{sh}	4.6 ^h	5.5 ^{vh}
	2014	2.1 ^l	2.6 ^{sl}	3.9 ^{sh}	4.4 ^{sh}	5.4 ^h
Caring	2012	2.8 ^{sl}	5.4 ^h	3.5 ^{sh}	5.4 ^h	5.6 ^{vh}
	2013	3.8 ^{sh}	5.6 ^{vh}	3.7 ^{sh}	5.5 ^{vh}	5.6 ^{vh}
	2014	3.6 ^{sh}	5.4 ^h	3.9 ^{sh}	5.5 ^{vh}	5.6 ^{vh}
Cluster N (%)	2012	29 (8.95%)	37 (11.42%)	56 (17.28%)	92 (28.40%)	107 (33.02%)
	2013	45 (14.61%)	40 (12.99%)	54 (17.53%)	92 (29.87%)	77 (25.00%)
	2014	24 (8.45%)	33 (11.62%)	48 (16.90%)	75 (26.41%)	104 (36.62%)

Note. All variables were significantly different between all clusters, p < .001. 2012 n = 324; 2013; n = 308; 2014 n = 284; N = 916.

^{vl} Very low = 1.0 to 1.4.

^l Low = 1.5 to 2.4.

^{sl} Somewhat low = 2.5-3.4.

^{sh} Somewhat high = 3.5 to 4.4.

^h High = 4.5 to 5.4.

^{vh} Very high = 5.5 to 6.0.

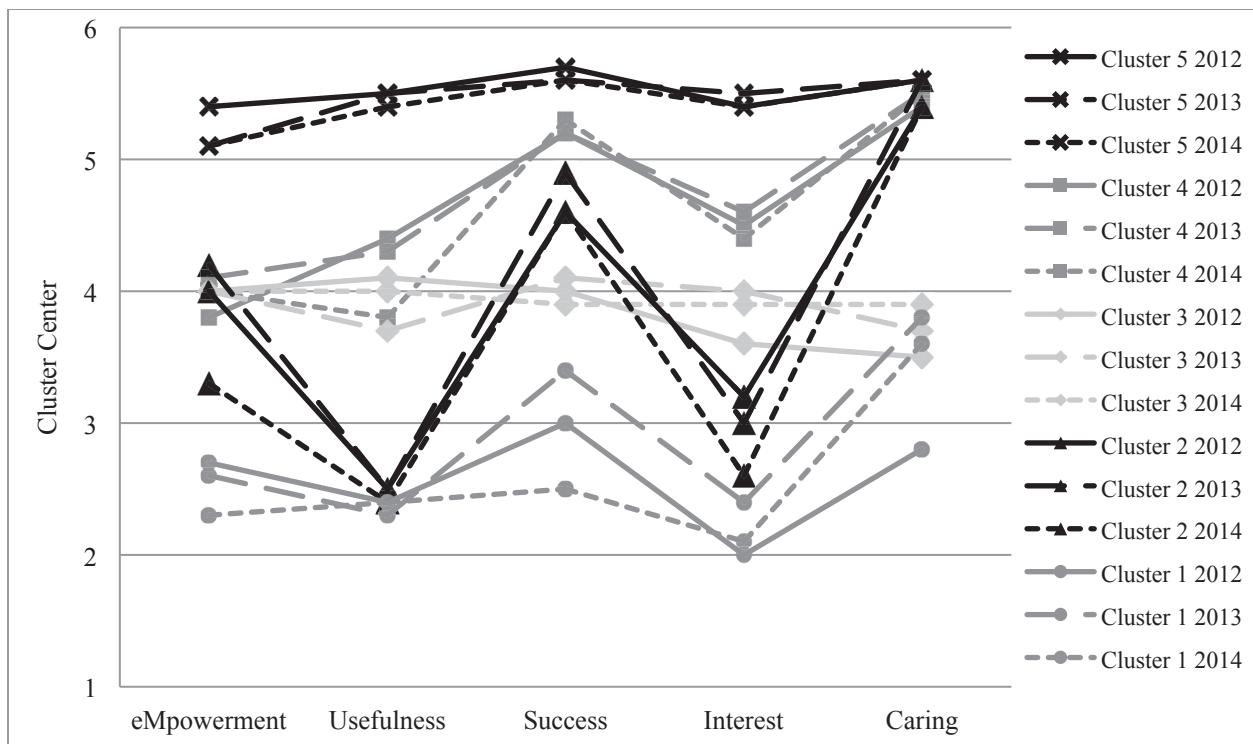


Figure 5. Cluster centers for each year (2012-2014). The five clusters are differentiated by different shades and marker styles: black with “X” marker = Cluster 5; dark grey with square marker = Cluster 4; light grey with diamond marker = Cluster 3; black with triangle marker = Cluster 2; dark grey with circle marker = Cluster 1. Years are demarcated with different lines: solid = 2012; large dashes = 2013; small dashes = 2014. This figure shows how the different clusters are stable across the years.

Initial cluster typology. Cluster solutions should also be interpretable with names and classifications informed by theory (Bacher, 2002). To define the cluster profiles, we first organized the cluster centers into five categories that described the students’ reported perceptions, per the 6-point scale: very low (1.0-2.4), low (2.5-3.4), moderate (3.5-4.4), high (4.5-5.4), and very high (5.5-6.0). We selected terminology that describes an amount or quantity of science class perceptions, similar to Daniels et al.’s (2008), Vansteenkiste et al.’s (2009),

Wormington et al.'s (2011), and Hyenga and Corpus's (2010) conception of low or high "quantity" motivation. The MMAMI items (see Appendix) measure the *quantity* of students' perceptions of the five MUSIC model components in a science class environment, rather than the *quality* of those perceptions.

Using the very low to very high categories to explain each variable's cluster center within the overall cluster membership, our initial characterization of the five clusters follows: (1) low motivation; (2) low usefulness and interest, moderate empowerment, and high success and caring; (3) somewhat high motivation; (4) somewhat high empowerment and values, and high success and caring; and (5) high motivation. Findings for these analyses are displayed in Table 6. The average percentage of students per cluster was similar across years, with the majority of students (55-63%) assigned to Clusters 4 and 5. One-way ANOVAs indicated that all five clusters were significantly different ($p < .001$), which is expected because the purpose of cluster analysis is to maximize within-cluster homogeneity and between-cluster heterogeneity. Intercorrelations were also low (-.006 to .110), supporting this conclusion.

Discriminant analysis. To further distinguish each motivation profile, we computed a discriminant factor analysis with the 2014 dataset (Burns & Burns, 2008). Four functions emerged, which was expected because the maximum number of functions possible is the number of clusters minus one (Burns & Burns, 2008). Table 7 includes structure coefficients for the four functions. Function 1 (D_1) is the dominant function, as it explained 83% of the between-groups variance and, together, D_1 and D_2 explained 98.5%. D_3 and D_4 were responsible for only a negligible amount of explained variance (1.6% combined) and were not key factors in cluster membership for any of our five profiles. Accordingly, and with our descriptive intention in mind, we omitted D_3 and D_4 from these results to maintain a parsimonious model.

Table 7

Discriminant Function Analysis, 2014

Function	Eigenvalue	% of variance	Canonical correlation	χ^2	df	Interpretation
D ₁	7.165	83.1	.937	853.7	20	High expectancy and value
D ₂	1.324	15.4	.755	269.9	12	High support, low relevance
D ₃	0.082	1.0	.275	35.5	6	--
D ₄	0.050	0.6	.219	13.6	2	--

We interpreted D₁ and D₂ using the discriminant loadings, which are Pearson correlations between the functions and MUSIC model variables, and indicate which variables were most important or influential within each function (Burns & Burns, 2008). D₁ is associated with a high level of interest, success, and usefulness, in order. Empowerment and caring were considered less critical factors. To simplify the interpretation of these findings, we labeled this function “high expectancy and value,” as expectancy for success corresponds with success in the MUSIC model, and interest and usefulness correspond with two “values” (i.e., interest value and utility value, respectively) in expectancy-value theory (Wigfield & Eccles, 2000). This function explained 83% of the between-groups variance. D₂ is primarily associated with a high level of perceived caring (the most important predictor), as well as with high perceived success and low usefulness, which were similarly weighted. Because caring often supports success perceptions, students with higher levels of perceived success and caring would likely feel supported in the learning environment (Wigfield, Cambria, & Eccles, 2012). Accordingly, we termed this function “high support and low usefulness.” Neither empowerment nor interest was significant in this model.

Table 8 shows the discriminant functions at each cluster centroid. The discriminant function coefficient at Cluster 1 indicates very low expectancy and value (-5.78), suggesting that students’ very low perceived expectancy and value were prominent influences of membership in

the low motivation profile. Empowerment was not a meaningful factor in cluster membership and associations with all other functions were low. Cluster 2 membership suggests low expectancy and value (-2.82) and, at the same time, high support and low relevance (2.09). Cluster 2 is consistent with a profile with high support, moderate expectancy, and very low value. We indicated a moderate level of expectancy because the success variable was contradictory between functions, with low success in D₁ and high success in D₂, and the canonical discriminant function coefficients were similarly weighted. Empowerment was not a meaningful factor in cluster membership and influences of other functions were low. Cluster 3 was moderately low on the high support and low relevance factor (-1.73), and moderately low on the expectancy and value factor (-1.61). Thus, Cluster 3 suggests that these students held fairly moderate to somewhat high perceptions of all variables, and that empowerment was not an influential factor in cluster membership. Cluster 4 indicates that no single variable or factor was especially influential in cluster membership in that no function was particularly significant; rather, the similar correlation coefficients suggest a combination of several influential variables. Finally, students in Cluster 5 indicated high expectancy and value (2.78), which was more important to their cluster membership. These findings are the inverse of Cluster 1, the “low motivation” profile, in which extremely low perceptions of expectancy and value held weight.

Table 8

Unstandardized Canonical Discriminant Functions at Cluster Centroid, 2014

Cluster	Function			
	D ₁ “High expectancy and value”	D ₂ “High support and low relevance”	D ₃	D ₄
1	-5.783	-0.881	0.029	0.519
2	-2.817	2.087	0.436	-0.195
3	-1.614	-1.733	-0.033	-0.331
4	0.268	0.855	-0.422	-0.004
5	2.780	-0.276	0.175	0.098

Note. **Bold** font indicates the most important factors to cluster membership.

Final cluster typology. Combining results of the discriminant analysis with our earlier categorization based on the cluster centers of each MUSIC model variable, we developed the following labels to describe each cluster: (1) *low motivation*; (2) *low value and high support*; (3) *somewhat high motivation*; (4) *somewhat high empowerment and values, and high support*; and (5) *high motivation*.

Stage 2: Stability tests. To test the stability of the clusters when organized into different subsets, we first followed the same two-step clustering procedure for separate grade levels (fifth, sixth, seventh) rather than years. These stability tests were intended to reduce the teacher effect and effects of unknown and contextual variables. We found that the cluster solution and cluster centers remained stable. The five-cluster solution best fit each grade level and the cluster centers aligned with the 2012, 2013, and 2014 clusters. See Table 9 for the cluster centers by grade level and Figure 6 for a visual of the five clusters and their stability at each grade level.

Table 9

Five-Cluster Solution: Comparisons Among Grade Levels

	Year	Cluster				
		1	2	3	4	5
		Low	Low value and high support	Somewhat high	Somewhat high empowerment and values, high support	High
eEmpowerment	5th	2.2 ^l	3.5 ^{sh}	4.0 ^{sh}	4.2 ^{sh}	5.4 ^h
	6th	2.8 ^{sl}	3.8 ^{sh}	4.1 ^{sh}	4.0 ^{sh}	5.1 ^h
	7th	2.8 ^{sl}	2.9 ^{sl}	4.0 ^{sh}	3.9 ^{sh}	5.1 ^h
Usefulness	5th	2.5 ^{sl}	2.3 ^l	3.9 ^{sh}	4.5 ^h	5.6 ^{vh}
	6th	2.3 ^l	2.5 ^{sl}	3.9 ^{sh}	4.2 ^{sh}	5.4 ^h
	7th	2.9 ^{sl}	1.8 ^l	4.0 ^{sh}	3.8 ^{sh}	5.3 ^h
Success	5th	2.5 ^{sl}	4.6 ^h	4.2 ^{sh}	5.3 ^h	5.7 ^{vh}
	6th	3.0 ^{sl}	4.7 ^h	3.5 ^{sh}	5.0 ^h	5.7 ^{vh}
	7th	3.0 ^{sl}	4.2 ^{sh}	4.3 ^{sh}	5.2 ^h	5.6 ^{vh}
Interest	5th	2.3 ^l	3.0 ^{sl}	3.9 ^{sh}	4.8 ^h	5.5 ^{vh}
	6th	2.1 ^l	3.1 ^{sl}	4.0 ^{sh}	4.3 ^{sh}	5.5 ^{vh}
	7th	2.3 ^l	2.2 ^l	3.9 ^{sh}	4.2 ^{sh}	5.3 ^h
Caring	5th	3.0 ^{sl}	5.6 ^{vh}	3.9 ^{sh}	5.6 ^{vh}	5.8 ^{vh}
	6th	3.5 ^{sh}	5.3 ^h	3.6 ^{sh}	5.3 ^h	5.5 ^{vh}
	7th	2.7 ^{sl}	5.2 ^h	3.6 ^{sh}	5.5 ^{vh}	5.5 ^{vh}
Cluster N (%)	5th	15 (4.62%)	42 (12.92%)	50 (15.38%)	113 (34.56%)	105 (32.31%)
	6th	30 (11.36%)	40 (15.15%)	32 (12.12%)	75 (28.41%)	87 (32.95%)
	7th	42 (12.84%)	34 (10.4%)	66 (20.18%)	94 (28.75%)	91 (27.83%)

Note. All variables were significantly different between all clusters, $p < .001$. Fifth-grade $n = 325$; sixth-grade $n = 264$; seventh-grade $n = 327$; $N = 916$.

^{vl} Very low = 1.0 to 1.4.

^l Low = 1.5 to 2.4.

^{sl} Somewhat low = 2.5-3.4.

^{sh} Somewhat high = 3.5 to 4.4.

^h High = 4.5 to 5.4.

^{vh} Very high = 5.5 to 6.0.

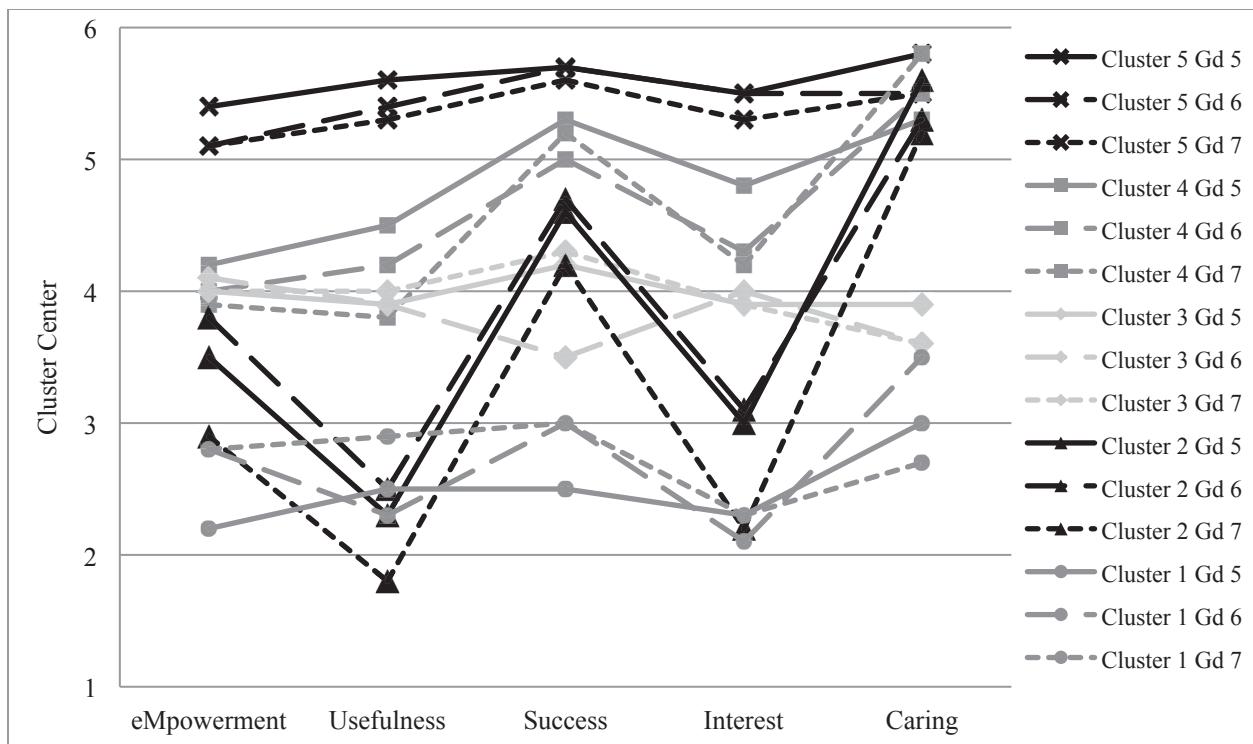


Figure 6. Cluster centers for each grade level (fifth, sixth, seventh). The five clusters are differentiated by different shades and marker styles: black with “X” marker = Cluster 5; dark grey with square marker = Cluster 4; light grey with diamond marker = Cluster 3; black with triangle marker = Cluster 2; dark grey with circle marker = Cluster 1. Grade levels are demarcated with different lines: solid = fifth grade; large dashes = sixth grade; small dashes = seventh grade. This figure shows how the different clusters are stable across the grade levels.

Prior to computing a secondary stability test with all 916 cases in a single sample, we selected the 167 students who completed the questionnaire at more than one time point and ran a series of Cohen’s κ tests to compare their cluster memberships between years. This allowed us to answer the question, “Did the students stay in the same cluster every year?” We found that students’ cluster memberships varied across years, suggesting that cluster membership may be dependent on the context of each specific science class: between 2012 and 2013, $\kappa = .191$ ($n =$

149); between 2012 and 2014, $\kappa = .135$ ($n = 65$); and between 2013 and 2014, $\kappa = .290$ ($n = 47$).

This finding led us to conclude that all 916 cases could be considered independent cases in this study, and could be included in one two-step cluster analysis.

We then computed a cluster analysis with the full sample sorted randomly such that students serving as more than one case were not “neighbors” during the analysis. The resulting cluster solution and cluster centers further indicate stability of the motivation profiles for science class within the population we examined. See Table 10 for the overall sample cluster centers. Figure 7 depicts alignment between cluster solutions and cluster center averages for the year, grade, and the full sample analyses.

Table 10

Five-Cluster Solution: Comparisons of Year, Grade Level, and All Combined

		Cluster				
		1 Low	2 Low value and high support	3 Somewhat high	4 Somewhat high empowerment and values, high support	5 High
Year						
eEmpowerment	All M	2.6 ^{sl}	3.6 ^{sh}	4.0 ^{sh}	4.2 ^{sh}	5.3 ^h
	Yr M	2.5 ^{sl}	3.8 ^{sh}	4.0 ^{sh}	4.0 ^{sh}	5.2 ^h
	Gd M	2.6 ^{sl}	3.4 ^{sl}	4.0 ^{sh}	4.0 ^{sh}	5.2 ^h
Usefulness	All M	2.4 ^l	2.6 ^{sl}	4.0 ^{sh}	4.4 ^{sh}	5.6 ^{vh}
	Yr M	2.4 ^l	2.5 ^{sl}	3.9 ^{sh}	4.2 ^{sh}	5.5 ^{vh}
	Gd M	2.6 ^{sl}	2.2 ^l	4.0 ^{sh}	4.2 ^{sh}	5.4 ^h
Success	All M	3.1 ^{sl}	4.7 ^h	4.1 ^{sh}	5.3 ^h	5.7 ^{vh}
	Yr M	3.0 ^{sl}	4.7 ^h	4.0 ^{sh}	5.2 ^h	5.7 ^{vh}
	Gd M	2.8 ^{sl}	4.5 ^h	4.0 ^{sh}	5.1 ^h	5.7 ^{vh}
Interest	All M	2.2 ^l	3.2 ^{sl}	3.9 ^{sh}	4.6 ^h	5.5 ^{vh}
	Yr M	2.2 ^l	2.9 ^{sl}	3.8 ^{sh}	4.5 ^h	5.4 ^h
	Gd M	2.3 ^l	2.8 ^{sl}	3.9 ^{sh}	4.4 ^{sh}	5.4 ^h
Caring	All M	3.4 ^{sl}	5.4 ^h	3.7 ^{sh}	5.5 ^{vh}	5.7 ^{vh}
	Yr M	3.4 ^{sl}	5.5 ^{vh}	3.7 ^{sh}	5.5 ^{vh}	5.6 ^{vh}
	Gd M	3.1 ^{sl}	5.3 ^h	3.7 ^{sh}	5.5 ^{vh}	5.6 ^{vh}
Cluster N (%)	All %	100 (10.9%)	138 (15.1%)	162 (17.7%)	277 (30.2%)	239 (26.1%)
	Yr % M	10.67%	12.01%	17.23%	28.23%	31.55%
	Gd % M	9.61%	12.82%	15.89%	30.57%	31.03%

Note. All = All 916 cases in a single cluster analysis. All = cluster center (M) for full sample of

916 cases; Yr M = cluster center (M) for all three years (2012, 2013, 2014); Gd M = cluster center (M) for all three grade levels (fifth, sixth, seventh).

^{vl} Very low = 1.0 to 1.4.

^l Low = 1.5 to 2.4.

^{sl} Somewhat low = 2.5-3.4.

^{sh} Somewhat high = 3.5 to 4.4.

^h High = 4.5 to 5.4.

^{vh} Very high = 5.5 to 6.0.

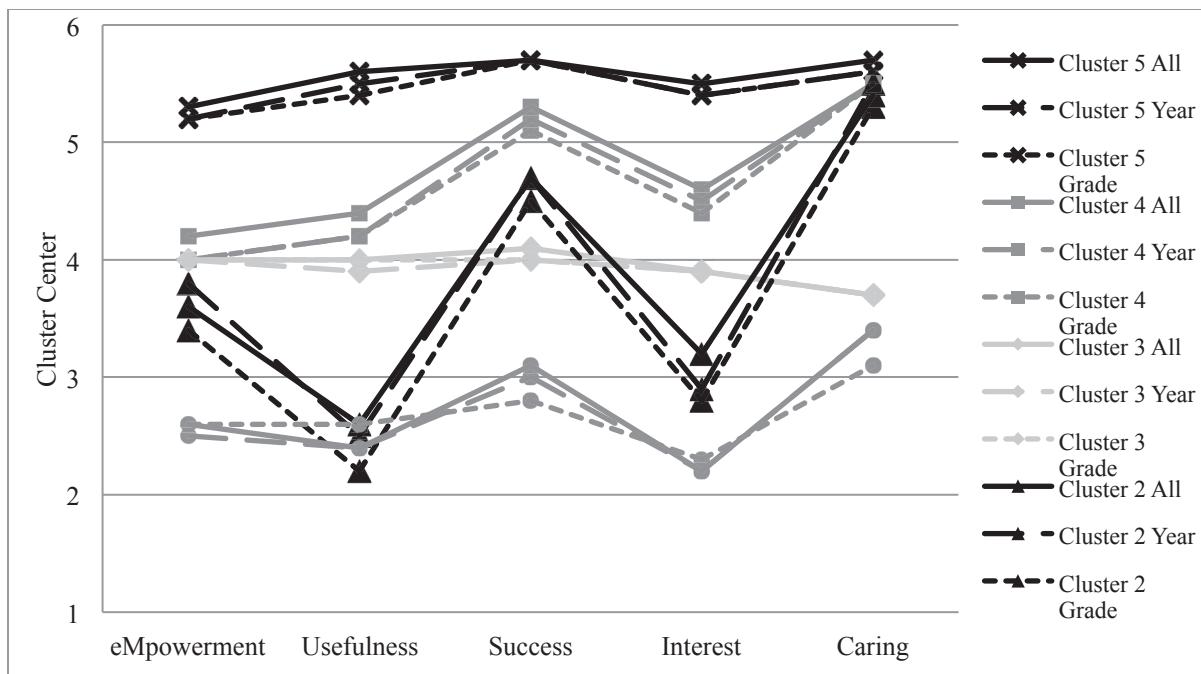


Figure 7. Mean cluster centers for all data: all 916 cases used in one cluster analysis (All), the mean of the cluster centers for 2012-2014 (Year), and the mean for all grade levels (Grade). The five clusters are differentiated by shade and marker style: black, “X” marker = Cluster 5; dark grey, square marker = Cluster 4; light grey, diamond marker = Cluster 3; black, triangle marker = Cluster 2; dark grey with circle marker = Cluster 1. All, Year, and Grade are demarcated with different lines: solid = All; large dashes = Year; small dashes = Grade. This figure depicts cluster stability.

Grade level and sex associations. We investigated grade level and sex differences among motivation profiles among clustered students that reported grade level and sex. Pearson chi-square tests revealed significant differences between grade levels, $\chi^2(8, n = 916) = 13.27, p < .001$, and sexes, $\chi^2(4, n = 913) = 13.57, p = .009$. In Cluster 5, fifth-grade students were overrepresented and seventh-grade students were underrepresented. Seventh-grade students were overrepresented in Clusters 1 and 3. Sixth-grade cluster assignments were proportional. A higher proportion of female students were assigned to Clusters 4 and 5, and males were overrepresented in Cluster 3.

Predictive Validity

To provide more evidence for the predictive validity of our cluster solution (Bacher, 2002), we completed several follow-up tests on the 2014 data with variables that have been shown to correlate theoretically and empirically: (a) science interest value, (b) science attainment value, (c) science utility value, (d) science competence beliefs, (e) science class effort, and (f) science grade estimate. We selected the 2014 data ($n = 284$) to act as exemplar, as the motivation profiles were relatively similar across years. The results are presented in Figure 8 and summarized in the following sections.

Science interest value. A one-way ANOVA indicated significant differences among motivation profiles in science class and students' reported interest value for science, $F(4, 279) = 42.83, p < .001$. Post hoc Tukey HSD and Games-Howell tests revealed significantly higher reported interest value in Cluster 5 ($M = 5.02$) than those students in Clusters 4 ($M = 4.11$) and 3 ($M = 3.84$). Students in the Cluster 2 ($M = 3.02$) and Cluster 1 ($M = 2.42$) reported the lowest science interest value.

Science attainment value. A one-way ANOVA indicated significant differences among motivation profiles in science class and students' reported science attainment value, $F(4, 279) = 57.04, p < .001$. Post hoc Tukey HSD and Games-Howell tests revealed significantly higher reported attainment value in Cluster 5 ($M = 5.30$) than in Cluster 4 ($M = 4.63$). Students in Cluster 4 reported attainment value that was significantly higher than in Clusters 2 ($M = 3.94$) and 3 ($M = 3.93$). Students in Cluster 1 ($M = 2.88$) reported the lowest science attainment value.

Science utility value. A one-way ANOVA indicated significant differences among motivation profiles in science class and students' reported science utility value, $F(4, 279) = 67.24, p < .001$. Post hoc Tukey HSD and Games-Howell tests revealed significantly higher reported science

utility value in Cluster 5 ($M = 5.05$) than those students in Clusters 3 ($M = 3.86$) and 4 ($M = 3.81$).

Students in Clusters 2 ($M = 2.84$) and 1 ($M = 2.21$) reported the lowest science utility value.

Science competence beliefs. A one-way ANOVA indicated significant differences among motivation profiles in science class and students' reported science competence beliefs, $F(4, 279) = 25.42, p < .001$. Tukey HSD and Games-Howell post hoc tests revealed that students in Cluster 5 ($M = 5.18$) reported higher science competence than those in Clusters 4 ($M = 4.69$) and 2 ($M = 4.46$). Students in Cluster 2 reported similar science competence as Cluster 3 ($M = 4.24$). Students in Cluster 1 reported the lowest science competence beliefs ($M = 3.40$).

Science class effort. A one-way ANOVA indicated significant differences among motivation profiles for science class and reported effort in class, $F(4, 279) = 60.88, p < .001$. Post hoc Tukey HSD and Games-Howell tests revealed significantly higher reported effort in Cluster 5 ($M = 5.50$) than those students in Cluster 4 ($M = 4.82$), who reportedly put forth significantly higher effort than those in Clusters 3 ($M = 4.18$) and 2 ($M = 4.11$) who, in turn, reported higher effort in science class than students in Cluster 1 ($M = 3.13$).

Science class grade estimate. A one-way ANOVA indicated significant differences among motivation profiles in science class and students' estimated grades, $F(4, 266) = 11.28, p < .001$. Tukey HSD post hoc tests revealed that students in Cluster 5 ($M = 8.14$, grades between A and A-), Cluster 4 ($M = 8.00$, or A-), and Cluster 2 ($M = 7.31$, grades between A- and B+) all reported similarly high estimated grades in science class. However, students in Cluster 2 also reported similar grades as those in Cluster 3 ($M = 6.24$, grades between B+ and B), who likewise reported similar estimated grades as students in Cluster 1 ($M = 5.61$, grades between B and B-), who reported the lowest grades of all profiles. All average estimated grades were relatively high, ranging between B and A.

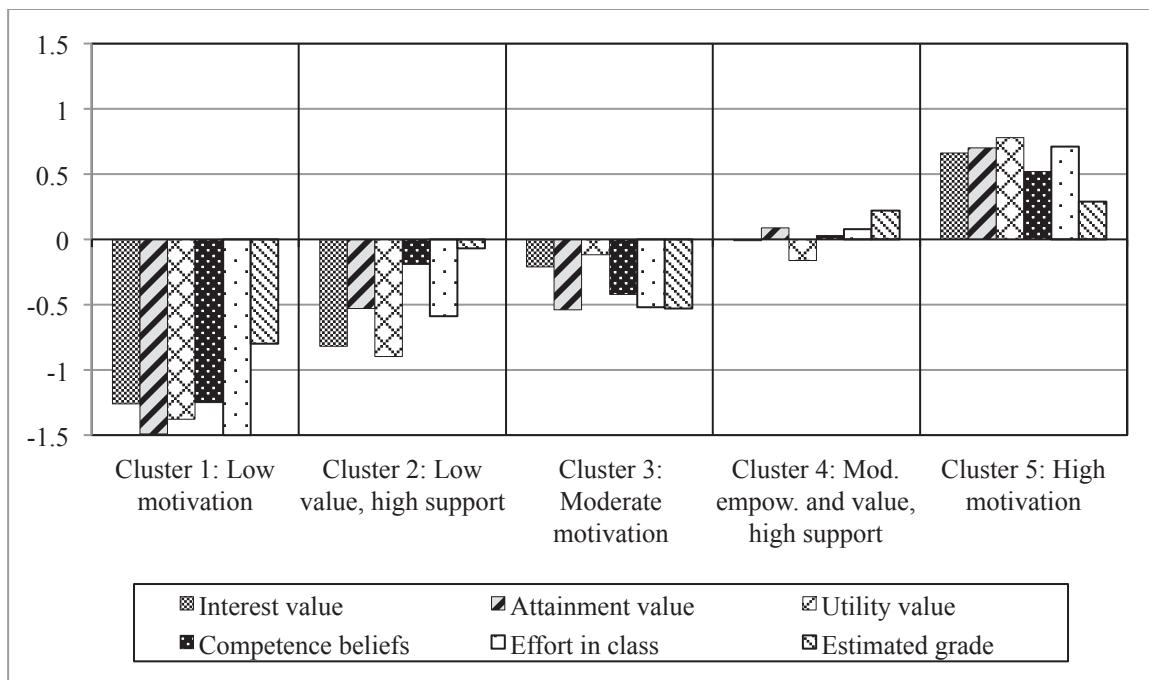


Figure 8. 2014 cluster comparisons across correlated variables. Values were converted to z-scores so that they are comparable in the figure. Each bar represents one variable. Each section represents one cluster.

Discussion

Our objective was to use a person-centered approach to categorize students into multidimensional motivation profiles in science class based on five well-known motivation constructs, depicting the dynamic and interactive nature of motivation. Incorporating constructs from multiple motivation theories allowed us to provide a broader, and possibly richer, conception of students' motivation. Furthermore, our use of person-centered analyses allowed us to identify complex patterns and offer a more inclusive view of students' motivation than more commonly-used linear research methods (Meece & Holt, 1993). To our knowledge, researchers have not yet used cluster analysis to examine the motivation of upper-elementary and middle school students in this manner. Our study demonstrates that patterns of science class perceptions

form five stable clusters, which are theoretically meaningful and depict students' multidimensional motivation profiles.

We describe the five profiles in more detail next, including their associations with other measures (as shown in Figure 8), to provide evidence of predictive validity. We classified each cluster according to the quantity of motivation reported (i.e., cluster centers and descriptive statistics) and the factors that were most important to cluster membership, per the discriminant analysis reported earlier.

Profile Descriptions

Cluster 1: Low motivation profile. Students in Cluster 1 reported a lower quantity of motivation for science class than students in the other clusters. The motivation profile for these students is primarily characterized by very low perceived expectancies (success) and values (interest and usefulness). Although less influential in determining cluster membership, they also perceived low empowerment in science class and felt that their teachers were only moderately caring.

Students in Cluster 1 reported significantly lower performance (between B- and B) than the other groups, except for Cluster 3. These students also held negative science competence beliefs and applied little effort to their studies in science class relative to those assigned to the other profiles. Likewise, they indicated minimal attainment value for science and reported that science was not very interesting and held little utility in their lives. These findings are consistent with previous research positing that students with low motivation often perform more poorly and hold negative beliefs (e.g., Legault, Green-Demers, & Pelletier, 2006).

Cluster 2: Low value and high support profile. Students in Cluster 2 reported that they held low values and had little control over their learning in science class; however, they expected

to be successful and felt cared for in the classroom. This profile is primarily characterized by high perceived support, moderate expectancy, and very low values.

Students in Cluster 2 reported that their grades were fairly high (B+ average), which is statistically similar to Clusters 3, 4, and 5. Consistent with their class grade estimates, students in Cluster 2 felt that they were fairly good at science in general (similar to Clusters 3 and 4) and asserted some effort class. However, doing well in science was only somewhat important to them, like students in Cluster 3. Aligning with their low values in science class, they indicated that the field of science did not hold much interest or utility for their lives, similar to students in Cluster 1. Overall, these students may not have perceived much value or experienced much enjoyment in science class, and felt little control over their learning, but they asserted some effort in class, expected to do fairly well, and believed that their teachers cared about their academic and personal well-being.

Cluster 3: Somewhat high motivation profile. Students in Cluster 3 reported that they perceived only somewhat high levels of empowerment, usefulness, success, interest, and caring in their science classes. They reported grades statistically similar to the low motivation profile (B average), suggesting that even somewhat high quantity motivation may be insufficient for highly positive achievement outcomes. We propose that a lack of highly positive support (caring and success) differentiates this profile from Clusters 2 and 4. Cluster 3 students reported somewhat high competence beliefs and value for doing well in science similar to, yet somewhat higher than, Cluster 2, although their reported grades were lower. They found science only somewhat interesting and useful to their lives, comparable to Cluster 4. Moreover, mean values for usefulness and interest in science class were not substantially lower than Cluster 4, and their

perceived empowerment was essentially equivalent. Overall, these students held somewhat high motivational beliefs although their reported performance was relatively poor.

Cluster 4: Somewhat high empowerment and values, and high support profile. Cluster 4 students perceived a somewhat high amount of empowerment, moderate to high perceptions of usefulness and interest, and expected to be very successful and perceived a high level of caring in class. Students in Cluster 4 reported that their grades were fairly high (A- average), statistically similar to Clusters 5 and 2 (the two other profiles that also all indicated high support). Students in Cluster 4 reported that they felt competent in science, similar to those in Cluster 2. They exerted much effort in science class and believed that being successful in science was important. However, they conveyed only some interest in science as a field and felt it was only somewhat useful to their lives. Overall, these students held only moderate values; regardless, they placed importance on doing well, tried hard, expected to be successful, and believed that their teachers cared about their well-being.

We examined dissimilarities between Clusters 2 and 4 more closely. In general, it appears that lower values for science and science class in Cluster 2 are the key distinctions, which corresponded to reported effort. This is evidenced in several ways. First, mean values for each MUSIC model component indicate that the profiles are similar except that in Cluster 4, interest and usefulness (values) were much higher, and expectancy for success was slightly higher. Also, perceived empowerment, grade estimate, and science competence beliefs were similar between profiles; however, those in Cluster 2 reportedly extended significantly less effort in science class, and their interest, utility, and attainment values for science were notably lower.

Cluster 5: High motivation profile. Students in Cluster 5 reported higher quantity motivation for science class than students in the other clusters. Discriminant analysis revealed that

their motivation for science class was primarily characterized by high expectancy and values. Although less influential in determining cluster membership, they also generally perceived that they had control over their learning in science class and felt that their teachers were highly caring. Students in this cluster reported superior grade estimates (between A and A-). They also highly valued science and their success in science, believed that they were competent, and put forth a great deal of effort in class. These findings are consistent with previous research, which suggests that students with high motivation often perform better and hold more positive motivation-related beliefs (Schunk et al., 2014).

Trends Across Profiles

We identified several important trends that helped us unravel these students' motivations. First, high expectancies for success and perceived caring in science class were related to students' achievement in science class. As evidence, estimated grades were similarly high across Clusters 2, 4, and 5—the high support profiles—as were science competence beliefs. It is important to note that, although perceived caring was relatively stable across Clusters 2, 4, and 5, expectancies for success increased from Cluster 2 to 4 to 5. Expectancies and caring were also indicative of relatively high achievement even when usefulness and interest were scarce in Clusters 2 and 4. Students in Clusters 1 and 3 reported relatively low estimated grades and are characterized by only somewhat low or somewhat high perceived support. Overall, these findings indicate that high perceived success and caring may be critical to student achievement in class, even when values are lower. Our findings align with previous research indicating the general importance of perceived support (Bandura, 1986; Wang & Eccles, 2013) and, specifically, that ability self-perceptions (Legault et al., 2006; Spinath, Spinath, Harlaar, &

Plomin, 2006; Steinmayr & Spinath, 2008) and perceived teacher caring (Roehrig et al., 2012; Ryan & Patrick, 2001) can predict achievement.

Second, values (i.e., usefulness/utility value and interest/interest value) tended to be lower than expectancies for success and caring for most profiles. Only the high motivation profile students reported high usefulness and interest for science class and the field of science. This evidence may imply that values are not as critical as expectancies for immediate classroom achievement, a finding consistent with others who have documented that expectancies are more predictive of junior high school students' performance than values (Meece, Wigfield, & Eccles, 1990). However, these patterns may also indicate that, although students believe that they can be successful in Clusters 2 and 4, they may not have any particular desire to engage in a task, unlike those in Cluster 5 (e.g., Eccles, Wigfield, & Schifale, 1998). There is previous evidence suggesting that a combination of high expectancies and values is positively associated with persistence, effort, course selection, and choice of college major (Aschbacher, Ing, & Tsai, 2014; Eccles et al., 1983)—outcomes especially salient in the present study. Furthermore, lack of values has been related to amotivation, attrition, and other negative outcomes (Ryan & Deci, 2000; Legault et al., 2006; Renninger, Hidi, & Krapp, 1992). We propose that students in Cluster 5 are more likely to persist in science and perform well in the future. We do not present evidence to explain whether values were lower in Clusters 1 through 4 or whether success and caring were simply higher (i.e., students perceived science class as easier and believed that their teachers were caring). Future research is needed to better understand the implications of these findings.

Third, a high level of perceived empowerment in science class was noted only in Cluster 5. This finding is consistent with self-determination theory (Deci & Ryan, 2000) in that motivation associated with more positive outcomes is considered more autonomous (i.e.,

internalized motivation and intrinsic motivation; Deci & Ryan, 2012; Ryan, 1995) and higher quality (Vansteenkiste, Lens, & Deci, 2006). Prior investigations indicated that students who are given some autonomy and hold high values for the task—as in Cluster 5—are more likely to function positively (e.g., increased engagement; Assor, Kaplan, & Ross, 2002), and that provision of fewer choices has predicted decreased values (Midgley & Feldlaufer, 1987). Furthermore, the measure we utilized for interest in science class is analogous to some measures of intrinsic motivation (e.g., Reeve, 1989), implying that students in Cluster 5 both perceived more empowerment in science class and were more autonomously motivated than in all other profiles. These findings require further investigation, as we did not measure direction in the present study nor do we attempt to assert causal relationships. Furthermore, empowerment did not present as an influential variable in discriminant analysis, indicating that it may not be as important as the other variables in categorizing students into a particular profile.

Sex Differences

More female students were assigned to Clusters 4 and 5 than to Clusters 1, 2, and 3 combined, which is consistent with previous cluster analyses that indicated a higher proportion of female students in similarly high quantity motivation profiles (e.g., Ratelle et al., 2007; Wormington et al., 2012) and investigations of secondary level students more generally (e.g., Fischer, Schult, & Hell, 2013). Our findings indicate that female students were generally more motivated in science classes than their male counterparts, which contradicts some research suggesting that males are often more motivated in science courses (Meece, Glienke, & Burg, 2006). Our study is consistent with prior investigations finding that female students often perform on par with (Else-Quest, Mineo, & Higgins, 2013; Riegle-Crumb, King, Grodsky, & Muller, 2012), or better than (Voyer & Voyer, 2014), males in STEM courses during K-12 years,

even though they are less likely to pursue science majors in college or science-related careers (National Center for Science and Engineering Statistics, 2013; Riegle-Crumb et al., 2012).

Context-Dependent Motivation

Of those students who completed the survey at multiple time points, few retained the same profile during two or more years. This finding may support the notion that motivation-related perceptions often depend on the specific context of each class, which previous research suggests can be influenced by teachers and the educational environment (e.g., Dotterer & Lowe, 2011; Steinmayr & Spinath, 2008; Walker, Pressick-Kilborn, Arnold, & Sainsbury, 2004; Wang & Eccles, 2013). If so, these findings may underscore the importance of teachers' behaviors and instructional design in affecting students' motivation in science classes. However, more research is needed to support this notion, as other factors may have contributed to the transient cluster membership (e.g., home life, age/grade level, environmental influences on testing days).

Future Research and Limitations

This study serves as a proof of concept and, thus, is the first step in investigating motivation profiles of upper-elementary and middle school students in science considering five important motivation-related class perceptions (i.e., need for autonomy, utility value, expectancy for success, interest, and caring). More research will be needed to examine teacher effects, motivation profiles in different contexts (e.g., domains, grade levels, schools), effects of designing interventions for motivation profiles, and further understanding the implications of this person-centered approach. Moreover, collecting qualitative data may help us to better interpret and explain these profiles.

In general, self-report data is inherently subject to validity threats due to inaccurate assessment of personal beliefs, misunderstandings, and examining perceptions that may be novel

to participants and thus lack prior thought. In addition, because we did not collect each participant's actual science grade, the estimated grade measure is subject to validity errors. Research indicates that children in the elementary and middle grades can display inflated self-efficacy and expectations of performance (Bandura, 1997; Klassen, 2002). Students who perform lower are often less reliable in reporting actual grades for various reasons (Bandura, 1997; Kuncel et al., 2005; Klassen, 2002; Svanum & Bigatti, 2006), as are students in science courses compared to other subject areas (Kuncel et al., 2005).

As all students were enrolled in two schools in one rural area, the results of this study may only be generalizable to fifth- through seventh-grade students at rural, low-income schools in Southwest Virginia. In cluster analysis particularly, which is exploratory in nature, cluster membership and structure can vary depending on context so there is some concern with overgeneralization across samples, environments, and domains (Vansteenkiste et al., 2009). In addition, some have expressed unease in using cluster analysis, as the researcher's judgment enters the process when describing cluster themes (Huberty et al., 2005; Kaufman & Rousseeuw, 1990). Nonetheless, we believe that this study represents an important contribution in understanding how multidimensional motivation perceptions affect students' motivation in science classes.

References

- Ainsworth, M. D. S. (1973). The development of infant-mother attachment. In B. Caldwell & H. Ricciuti (Eds.), *Review of child development research* (Vol. 3, pp. 1-94). Chicago, IL: University of Chicago Press.
- Ainsworth, M. D. S. (1979). Infant-mother attachment. *American Psychologist*, 34(10), 932-937. doi:10.1037/0003-066X.34.10.932
- Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, 84(3), 261-271. doi:10.1037/0022-0663.84.3.261
- Aschbacher, P. R., Ing, M., & Tsai, S. M. (2014). Is science me? Exploring middle school students' STE-M career. *Journal of Science Education & Technology*, 23(6), 735-743. doi:10.1007/s10956-014-9504-x
- Asendorpf, J. B., Borkenau, P., Ostendorf, F., & van Aken, M. A. G. (2001). Carving personality description at its joints: Confirmation of three replicable personality prototypes for both children and adults. *European Journal of Personality*, 15, 169-198. doi:10.1002/per.408
- Bacher, J. (2002). *Cluster analysis*. Retrieved from <http://www.clusteranalyse.net/sonstiges/zaspringseminar2002/lecturenotes.pdf>
- Bacher, J., Wenzig, K., & Vogler, M. (2004). *SPSS twostep cluster: A first evaluation*. Retrieved from http://opus4.kobv.de/opus4-fau/files/74/a_04-02.pdf
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Baumeister, R., & Leary, M. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117(3), 497-529.
doi:10.1037/0033-2909.117.3.497

Bergin, C., & Bergin, D. (2009). Attachment in the classroom. *Educational Psychology Review*, 21, 141-170. doi:10.1007/s10648-009-9104-0

Bergin, D. A. (1999). Influences on classroom interest. *Educational Psychologist*, 34(2), 87-98.
doi:10.1207/s15326985ep3402_2

Bergman, L. R. (2001). A person approach in research on adolescence: Some methodological challenges. *Journal of Adolescent Research*, 16, 28-53. doi:10.1177/0743558401161004

Bong, M., & Skaalvik, E. M. (2003). Academic self-concept and self-efficacy: How different are they really? *Educational Psychology Review*, 15(1), 1-40. doi:10.1023/A:1021302408382

Bowlby, J. (1969). *Attachment* (Vol. I). New York, NY: Basic.

Burns, R., & Burns, R. (2008). *Business research methods and statistics using SPSS*. Thousand Oaks, CA: Sage.

Chawla, S., & Gionis, A. (2013). K-means: A unified approach to clustering and outlier detection. *Proceedings of the 2013 SIAM International Conference on Data Mining, USA*, 189-197. doi:10.1137/1.9781611972832.21

Chen, J. A. (2012). Implicit theories, epistemic beliefs, and science motivation: A person-centered approach. *Learning and Individual Differences*, 22, 724-735.
doi:10.1016/j.lindif.2012.07.013

Covington, M. V. (1992). *Making the grade: A self-worth perspective on motivation and school reform*. New York, NY: Cambridge University Press.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York, NY: Harper & Row.

Conley, A. M. (2012). Patterns of motivation beliefs: Combining Achievement goal and expectancy-value perspectives. *Journal of Educational Psychology, 104*(1), 32-47.
doi:10.1037/a0026042

Daniels, L. M., Haynes, T. L., Stupinsky, R. H., Perry, R. P., Newall, N. E., & Pekrun, R. (2008). Individual differences in achievement goals: A longitudinal study of cognitive, emotional, and achievement outcomes. *Contemporary Educational Psychology, 33*, 584-608. doi:10.1016/j.cedpsych.2007.08.002

deCharms, R. (1968). *Personal causation: The internal affective determinants of behavior*. New York, NY: Academic Press.

Deci, E. L. (1975). *Intrinsic motivation*. New York, NY: Plenum Press.

Deci, E. L., & Ryan, R. M. (1991). A motivational approach to self: Integration in personality. In R. Dentsbier (Ed.), *Nebraska symposium on motivation* (Vol. 38). Lincoln, NE: University of Nebraska Press.

Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227-268.

doi:10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (2012). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 85-107). New York, NY: Oxford University Press.

- De Volder, M., & Lens, W. (1982). Academic achievement and future time perspective as a cognitive-motivational concept. *Journal of Personality and Social Psychology*, 42(3), 566-571. doi:10.1037/0022-3514.42.3.566
- Dotterer, A. M., & Lowe, K. (2011). Classroom context, school engagement, and academic achievement in early adolescence. *Journal of Youth and Adolescence*. 40(12), 1649-1660. doi:10.1007/s10964-011-9647-5
- Eccles, J. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75-146). San Francisco, CA: W. H. Freeman.
- Eccles, J. S. (2005). Subjective task value and the Eccles et al. model of achievement-related choices. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105-121). New York: The Guilford Press.
- Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 75-146). San Francisco, CA: Freeman.
- Eccles, J. S., & Wigfield, A. (1995). In the mind of the actor: The structure of adolescents' achievement task values and expectancy-related beliefs. *Personality and Social Psychology Bulletin*, 21(3), 215-225. doi:10.1177/0146167295213003
- Eccles, J. S., Wigfield, A., Harold, R., & Blumenfeld, P. B. (1993). Age and gender differences in children's self- and task perceptions during elementary school. *Child Development*, 64(3), 830-847. doi:10.2307/1131221
- Eccles, J. S., Wigfield, A., & Schiefele, U. (1998). Motivation to succeed. In W. Damon & N. Eisenberg (Eds.), *Handbook of child psychology: Social, emotional, and personality*

- development* (5th ed., Vol. 3, pp. 1017-1095). Hoboken, NJ: Wiley.
- Elliot, A. J., & Dweck, C. S. (2005). Competence and motivation: Competence as the core of achievement motivation. In A. J. Elliot, & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 3-12). New York, NY: Guilford.
- Else-Quest, N. M., Mineo, C. C., & Higgins, A. (2013). Math and science attitudes and achievement at the intersection of gender and ethnicity. *Psychology of Women Quarterly*, 37(3), 293-309. doi:10.1177/0361684313480694
- Fischer, F., Schult, J., & Hell, B. (2013). Sex differences in secondary school success: Why female students perform better. *European Journal of Psychology of Education*, 28(2), 529-543. doi:10.1007/s10212-012-0127-4
- Fortus, D., & Vedder-Weiss, D. (2014). Measuring students' continuing motivation for science learning. *Journal of Research in Science Teaching*, 51(4), 497-522. doi:10.1002/tea.21136
- Fraley, C., & Raftery, A. E. (2002). Model-based clustering, discriminant analysis, and density estimation. *Journal of the American Statistical Association*, 97(458), 611-631. doi:10.1198/016214502760047131
- Gabel, A. D. (1992). *Validly of the constructs internalizing and externalizing in describing a late elementary school-aged sample* (Doctoral dissertation). Retrieved from ProQuest. (Order No. 9236823)
- Galbraith, J. K., & Jiaqing, L. (1999). *Cluster and discriminant analysis on time-series as a research tool*. Retrieved from http://utip.gov.utexas.edu/papers/utip_06.pdf
- Greene, B. A., Miller, R. B., Crowson, H. M., Duke, B. L., & Akey, K. L. (2004). Predicting high school students' cognitive engagement and achievement: Contributions of classroom

perceptions and motivation. *Contemporary Educational Psychology*, 29(4), 462-482.

doi:10.1016/j.cedpsych.2004.01.006

Hale, R. L., & Glassman, S. S. (1986). Using computers to construct, evaluate, and apply actuarial systems of classification: A methodology and example. *Computers in Human Behavior*, 2(3), 195-213. doi:10.1016/0747-5632(86)90003-8

Hartwell, M., & Kaplan, A. (2014, April). *A multidimensional analysis of context-specific perceived relevance among students with differing expectancy-value profiles*. Paper presented at the annual meeting of the American Educational Research Association, Philadelphia, PA.

Hayenga, A. O., & Corpus, J. H. (2010). Profiles of intrinsic and extrinsic motivations: A person-centered approach to motivation and achievement in middle school. *Motivation & Emotion*, 34, 371-383. doi:10.1007/s11031-010-9181-x

Hidi, S., & Harackiewicz, J. (2000). Motivating the academically unmotivated: A critical issue for the 21st century. *Review of Educational Research*, 70(2), 151-179.
doi:10.3102/00346543070002151

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, 41(2), 111-127. doi:10.1207/s15326985ep4102_4

Huberty, C. J., Jordan, E. M., & Brandt, W. C. (2005). Cluster analysis in higher education research. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. XX, 437-457). Dordrecht, The Netherlands: Springer. Retrieved from http://download.springer.com/static/pdf/461/chp%253A10.1007%252F1-4020-3279-X_8.pdf?auth66=1415289175_76ed37c1959eea20b222d074b6c074a1&ext=.pdf

- Hulleman, C. S., Durik, A. M., Schweigert, S. A., & Harackiewicz, J. M. (2008). Task values, achievement goals, and interest: An integrative analysis. *Journal of Educational Psychology, 100*(2), 398-416. doi:10.1037/0022-0663.100.2.398
- Jiang, M. F., Tseng, S. S., & Su, C. M. (2001). Two-phase clustering process for outliers detection. *Pattern Recognition Letters, 22*, 691-700. doi:10.1016/S0167-8655(00)00131-8
- Jones, B. D. (in press). Teaching motivation strategies using the MUSIC model of motivation as a conceptual framework. In M. C. Smith & N. DeFrates-Densch (Eds.), *Challenges and innovations in educational psychology teaching and learning*.
- Jones, B. D. (2009). Motivating students to engage in learning: The MUSIC model of academic motivation. *International Journal of Teaching and Learning in Higher Education, 21*(2), 272-285. Retrieved from <http://www.isetl.org/ijtlhe/pdf/IJTLHE774.pdf>
- Jones, B. D. (2010). An examination of motivation model components in face-to-face and online instruction. *Electronic Journal of Research in Educational Psychology, 8*(3), 915-944.
- Jones, B. D. (2012). *User guide for assessing the components of the MUSIC Model of Academic Motivation*. Retrieved from <http://www.MotivatingStudents.info>
- Jones, B. D. (2014). *Motivation and the MUSIC model*. Unpublished manuscript, Department of Learning Sciences and Technologies, Virginia Tech, Blacksburg, VA.
- Jones, B. D., Osborne, J. W., Paretti, M. C., & Matusovich, H. M., (2014). Relationships among students' perceptions of a first-year engineering design course and their engineering identification, motivational beliefs, course effort, and academic outcomes. *International Journal of Engineering Education, 30*(6A), 1340-1356.

- Jones, B. D., Paretti, M. C., Hein, S. F., & Knott, T. W. (2010). An analysis of motivation constructs with first-year engineering students: Relationships among expectancies, values, achievement, and career plans. *Journal of Engineering Education*, 99(4), 319-336. doi.org/10.1002/j.2168-9830.2010.tb01066.x
- Jones, B. D., Ruff, C., & Osborne, J. W. (in press). Fostering students' identification with mathematics and science. In K. A. Renninger, M. Nieswandt, & S. Hidi (Eds.), *Handbook on interest, the Self, and K-16 mathematics and science learning*. Washington, DC: American Educational Research Association.
- Jones, B. D., & Skaggs, G. (2012, August). *Validation of the MUSIC Model of Academic Motivation Inventory: A measure of students' motivation in college courses*. Research presented at the International Conference on Motivation 2012, Frankfurt, Germany.
- Jones, B. D., & Skaggs, G. E. (in press). Measuring students' motivation: Development of and validity evidence for the MUSIC Model of Academic Motivation Inventory. *International Journal of Educational and Psychological Assessment*.
- Jones, B. D., & Wilkins, J. L. M. (2013a). Testing the MUSIC Model of Academic Motivation through confirmatory factor analysis. *Educational Psychology*, 33(4), 482-503. doi:10.1080/01443410.2013.785044
- Jones, B. D., & Wilkins, J. L. M. (2013b, May). *Validity evidence for the use of a motivation inventory with middle school students*. Poster presented at the annual meeting of the Society for the Study of Motivation, Washington, DC.
- Jones, B. D., & Wilkins, J. (2015, February). *More validity evidence for the use of the MUSIC Model of Academic Motivation Inventory with upper-elementary and middle school*

students. Poster presented at the annual meeting of the Eastern Educational Research Association, Sarasota, Florida.

Jones, B. D., Wilkins, J. L. M., Long, M. H., & Wang, F. (2012). Testing a motivational model of achievement: How students' mathematical beliefs and interests are related to their achievement. *European Journal of Psychology of Education*, 27(1), 1-20.
doi:10.1007/s10212-011-0062-9

Jung, J.-S., Owusu-Antwi, E. B., & An, J.-H. (2006). Analytical procedures for evaluating factors that affect joint faulting for jointed plain concrete pavements using the long-term pavements performance database. *Canadian Journal of Civil Engineering*, 33, 1279-1286. doi:10.1139/L06-072

Kaplan, A., Katz, I., & Flum, H. (2012). Motivation theory in educational practice: Knowledge claims, challenges, and future directions. In K. R. Harris, S. G. Graham, & T. Urdan (Eds.), *APA educational psychology handbook: Individual differences, cultural considerations, and contextual factors in educational psychology* (Vol. 2, pp. 165-194). Washington, DC: American Psychological Association.

Kaplan, A., Katz, I., & Flum, H. (2014, April). Practice-relevant motivational research: Do we need a different approach? In L. Corno (Chair), *Practice-relevant motivational research: Do we need a different approach?* Symposium conducted at the annual meeting of the American Educational Research Association, Philadelphia, PA.

Katz, I., & Assor, A. (2007). When choice motivates and when it does not. *Educational Psychology Review*, 19(4), 429-442. doi:10.1007/s10648-006-9027-y

Klassen, R. (2002). Writing in early adolescence: A review of the role of self-efficacy beliefs. *Educational Psychology Review*, 14(2), 173-203. doi:10.1023/A:1014626805572

- Kuncel, N. R., Credé, M., & Thomas, L. L. (2005). The validity of self-reported grade point averages, class ranks, and test scores: A meta-analysis and review of the literature. *Review of Educational Research*, 75(1), 63-82. doi:10.3102/00346543075001063
- Lange, T., Roth, V., Braun, M. L., & Buhmann, J. M. (2004). Stability-based validation of clustering solutions. *Neural Computation*, 16(6), 1299-1323. doi:10.1162/089976604773717621
- Legault, L., Green-Demers, I., & Pelletier, L. (2006). Why do high school students lack motivation in the classroom? Toward an understanding of academic amotivation and the role of social support. *Journal of Educational Psychology*, 98(3), 567-582. doi:10.1037/0022-0663.98.3.567
- Lesko, A. C., & Corpus, J. H. (2006). Discounting the difficult: How high math-identified women respond to stereotype threat. *Sex Roles*, 54, 113-125. doi:10.1007/s11199-005-8873-2
- Maltese, A. V., & Tai, R. H. (2010). Eyeballs in the fridge: Sources of early interest in science. *International Journal of Science Education*, 32, 669-685. doi:10.1080/09500690902792385
- Marsh, H. W. (1990). A multidimensional, hierarchical model of self-concept: Theoretical and empirical justification. *Educational Psychology Review*, 2(2), 77-172. doi:10.1007/BF01322177
- Meece, J. L., Glienke, B. B., & Burg, S. (2006). Gender and motivation. *Journal of School Psychology*, 44, 351-373. doi:10.1016/j.jsp.2006.04.004
- Meece, J. L., & Holt, K. (1993). A pattern analysis of students' achievement goals. *Journal of Educational Psychology*, 85(4), 582-590. doi:10.1037/0022-0663.85.4.582
- Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its

consequences for young adolescents' course enrollment intentions and performances in mathematics. *Journal of Educational Psychology*, 82(1), 60-70. doi:10.1037/0022-0663.82.1.60

Midgley, C., & Feldlaufer, H. (1987). Students' and teachers' decision making fit before and after the transition to junior high school. *Journal of Early Adolescence*, 7(2), 225-241. doi:10.1177/0272431687072009

Miller, R. B., Greene, B. A., Montalvo, G. P., Ravindran, B., & Nichols, J. D. (1996). Engagement in academic work: The role of learning goals, future consequences, pleasing others, and perceived ability. *Contemporary Educational Psychology*, 21(4), 388-422. doi:10.1006/ceps.1996.0028

Mooi, E., & Sarstedt, M. (2011). *A concise guide to market research*. Berlin, Germany: Springer-Verlag. doi:10.1007/978-3-642-12541-6_9

National Academy of Sciences (NAS). (2007). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Washington, DC: National Academies Press. Retrieved from
<http://www.sandia.gov/NINE/documents/RisingAbove.pdf>

National Academy of Sciences (NAS). (2007). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Washington, DC: National Academies Press. Retrieved from
<http://www.sandia.gov/NINE/documents/RisingAbove.pdf>

National Center for Science and Engineering Statistics (NCSES). (2013). *Women, minorities, and persons with disabilities in science and engineering* (Special Report NSF 13-304). Arlington, VA: National Science Foundation. Retrieved from

http://www.nsf.gov/statistics/wmpd/2013/pdf/nsf13304_digest.pdf

Noddings, N. (1984). *Caring: A feminine approach to ethics and moral education*. Berkeley, CA: University of California Press.

Noddings, M. (1992). *The challenge to care in schools: An alternative approach to education*. New York, NY: Teachers College Press.

Norusis, M. J. (2011). *IBM SPSS statistics 19 statistical procedures companion*. Upper Saddle River, NJ: Prentice Hall.

Osborne, J. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, 25(9), 1049-1079.
doi:10.1080/0950069032000032199

Osborne, J. W., & Jones, B. D. (2011). Identification with academics and motivation to achieve in school: How the structure of the self influences academic outcomes. *Educational Psychology Review*, 23(1), 131-158. doi:10.1007/s10648-011-9151-1

Plant, R. W., & Ryan, R. M. (1985). Intrinsic motivation and the effects of self-consciousness, self-awareness, and ego-involvement: An investigation of internally-controlling styles. *Journal of Personality*, 53(3), 435-449. doi:10.1111/j.1467-6494.1985.tb00375.x

President's Council of Advisors on Science and Technology (PCAST). (2010). *Report to the President: Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America's future*. Retrieved from
<http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemmed-report.pdf>

President's Council of Advisors on Science and Technology (PCAST). (2012). *Report to the president: Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics*. Retrieved from

http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-executive-report-final_2-13-12.pdf

- Ratelle, C. F., Guay, F., Vallerand, R. J., Larose, S., & Senécal, C. (2007). Autonomous, controlled, and amotivated types of academic motivation: A person-oriented analysis. *Journal of Educational Psychology, 99*(4), 734-746. doi:10.1037/0022-0663.99.4.734
- Reeve, J. (1989). The interest-enjoyment distinction in intrinsic motivation. *Motivation and Emotion, 13*(2), 83-103. doi:10.1007/BF00992956
- Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and Emotion, 28*(2), 147-169. doi:10.1023/B:MOEM.0000032312.95499.6f
- Reeve, J., Nix, G., & Hamm, D. (2003). Testing models of the experience of self-determination in intrinsic motivation and the conundrum of choice. *Journal of Educational Psychology, 95*(2), 375-392. doi:10.1037/0022-0663.95.2.375
- Reilly, C., Wang, C., & Rutherford, M. (2005). A rapid method for the comparison of cluster analyses. *Statistica Sinica, 15*, 19-33. Retrieved from <http://www3.stat.sinica.edu.tw/statistica/oldpdf/A15n12.pdf>
- Renninger, K. A., Hidi, S., & Krapp, A. (Eds.). (1992). *The role of interest in learning and development*. Hillsdale, NJ: Lawrence Erlbaum.
- Riegle-Crumb, C., King, B., Grodsky, E., & Muller, C. (2012). The more things change, the more they stay the same? Prior achievement fails to explain gender inequality in entry into STEM college majors over time. *American Educational Research Journal, 49*(6), 1048-1073. doi:10.3102/0002831211435229
- Roehrig, A. D., Turner, J. E., Arrastia, M. C., Christesen, E., McElhaney, S., & Jakiel, L. M. (2012).

Effective teachers and teaching: Characteristics and practices related to positive student outcomes. In K. R. Harris, S. Graham, & T. Urdan (Eds.), *APA educational psychology handbook: Individual differences and cultural and contextual factors* (Vol. 2, pp. 501-527).

Washington, DC: American Psychological Association. doi:10.1037/13274-020

Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality*, 63(3), 397-427. doi:10.1111/j.1467-6494.1995.tb00501.x

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68-78. doi:10.1037/0003-066X.55.1.68

Ryan, A. M., & Patrick, H. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *American Educational Research Journal*, 38(2), 437-460. doi:10.3102/00028312038002437

Schmader, T., Major, B., & Gramzow, R. H. (2001). Coping with ethnic stereotypes in the academic domain: Perceived injustice and psychological disengagement. *Journal of Social Issues*, 57(1), 93-111. doi:10.1111/0022-4537.00203

Schraw, G., & Lehman, S. (2001). Situational interest: A review of the literature and directions for future research. *Educational Psychology Review*, 13(1), 23-52. doi:10.1023/A:1009004801455

Schunk, D. H., Meece, J. L., & Pintrich, P. R. (2014). *Motivation in education: Theory, research, and applications*. Columbus, OH: Pearson.

Schunk, D. H., & Pajares, F. (2005). Competence perceptions and academic functioning. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 141-163). New York, NY: Guilford.

- Schwinger, M., Steinmayr, R., & Spinath, B. (2012). Not all roads lead to Rome—Comparing different types of motivational regulation profiles. *Learning and Individual Differences*, 22, 269-279. doi:10.1016/j.lindif.2011.12.006
- Shell, D. F., & Husman, J. (2008). Control, motivation, affect, and strategic self-regulation in the college classroom: A multidimensional phenomenon. *Journal of Educational Psychology*, 100(2), 443-459. doi:10.1037/0022-0663.100.2.443
- Shell, D. F., & Soh, L. K. (2013). Profiles of motivated self-regulation in college computer science courses: Differences in major versus required non-major courses. *Journal of Science Education and Technology*, 22(6), 899-913. doi:10.1007/s10956-013-9437-9
- Simons, J., Vansteenkiste, M., Lens, W., & Lacante, M. (2004). Placing motivation and future time perspective theory in a temporal perspective. *Educational Psychology Review*, 16(2), 121-139. doi:10.1023/B:EDPR.0000026609.94841.2f
- Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology*, 42(1), 70-83. doi:10.1037/0012-1649.42.1.70
- Simpson, R. D., & Oliver, J. S. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. *Science Education*, 74(1), 1-18. doi:10.1002/sce.3730740102
- Spinath, B., Spinath, F. M., Harlaar, N., & Plomin, R. (2006). Predicting school achievement from general cognitive ability, self-perceived ability, and intrinsic value. *Intelligence*, 34, 363-374. doi:10.1016/j.intell.2005.11.004

- Smith, J. (2012, May 29). The 10 hardest jobs to fill in America. *Forbes*. Retrieved from <http://www.forbes.com/sites/jacquelynsmith/2012/05/29/the-10-hardest-jobs-to-fill-in-america-2/>
- Steinmayr, R., & Spinath, B. (2008). Sex differences in school achievement: What are the roles of personality and achievement motivation? *European Journal of Personality*, 22, 185-209. doi:10.1002/per.676
- Su, Y.-L., & Reeve, J. (2011). A meta-analysis of the effectiveness of intervention programs designed to support autonomy. *Educational Psychology Review*, 23(1), 159-188. doi:10.1007/s10648-010-9142-7
- Svanum, S., & Bigatti, S. (2006). Grade expectations: Informed or uninformed optimism, or both? *Teaching of Psychology*, 33(1), 14-18. doi:10.1207/s15328023top3301_4
- Tai, R., Liu, C. Q., Maltese, A. V., & Fan, X. T. (2006). Planning for early careers in science. *Science*, 312(5777), 1143-1144.
- Tuominen-Soini, H., Salmela-Aro, K., & Niemivirta, M. (2011). Stability and change in achievement goal orientations: A person-centered approach. *Contemporary Educational Psychology*, 36, 82-100. doi:10.1016/j.cedpsych.2010.08.002
- Turner, J. C., Christensen, A., Kackar-Cam, H. Z., Trucano, M., & Fulmer, S. M. (2014). Enhancing students' engagement: Report of a 3-year intervention with middle school teachers. *American Educational Research Journal*, 51(6), 1195-1226. doi:10.3102/0002831214532515
- Turner, J. C., & Meyer, D. K. (2000). Studying and understanding the instructional contexts of classrooms: Using our past to forge our future. *Educational Psychologist*, 35(2), 69-85. doi:10.1207/S15326985EP3502_2

- Turner, J. C., Thorpe, P. K., & Meyer, D. K. (1998). Students' reports of motivation and negative affect: A theoretical and empirical analysis. *Journal of Educational Psychology, 90*(4), 758-771. doi:10.1037/0022-0663.90.4.758
- Vansteenkiste, M., Lens, W., & Deci, E. L. (2006). Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. *Educational Psychologist, 41*(1), 19-31. doi:10.1207/s15326985ep4101_4
- Vansteenkiste, M., Sierens, El., Soenens, B., Luyckx, K., & Lens, W. (2009). Motivational profiles from a self-determination perspective: The quality of motivation matters. *Journal of Educational Psychology, 101*(3), 671-688. doi:10.1037/a0015083
- Vedder-Weiss, D., & Fortus, D. (2010). Adolescents' declining motivation to learn science: Inevitable or not? *Journal of Research in Science Teaching, 48*(2), 199-216. doi:10.1002/tea.20398
- Vijendra, S., & Shivani, P. (2014). *Robust outlier detection technique in data mining: A univariate approach* (Report No. MT CA 2011). Retrieved from Cornell University Library website: <http://arxiv.org/ftp/arxiv/papers/1406/1406.5074.pdf>
- Virginia Department of Education (VDOE). (2012). *Title I, Part A: Improving basic programs operated by local educational agencies*. Retrieved from http://www.doe.virginia.gov/federal_programs/esea/title1/part_a/
- Virginia Department of Education, Office of School Nutrition Programs (VDOE SNP). (2014). *School year 2013-2014 National School Lunch Program (NSLP) free and reduced price eligibility report: School level*. Retrieved from http://www.pen.k12.va.us/support/nutrition/statistics/free_reduced_eligibility/2013-2014/schools/frpe_sch_report_sy2013-14.pdf

- Voyer, D., & Voyer, S. D. (2014). Gender differences in scholastic achievement: A meta-analysis. *Psychological Bulletin, 140*(4), 1174-1204. doi:10.1037/a0036620
- Walker, R. A., Pressick-Kilborn, K., Arnold, L. S., & Sainsbury, E. J. (2004). Investigating motivation in context: Developing sociocultural perspectives. *European Psychologist, 9*(4), 245-256. doi:10.1027/1016-9040.9.4.245
- Wang, M.-T., & Eccles, J. S. (2013). School context, achievement motivation, and academic engagement: A longitudinal study of school engagement using a multidimensional perspective. *Learning and Instruction, 28*, 12-23. doi:10.1016/j.learninstruc.2013.04.002
- Weissman, J., & Magill, B. A. (2008). Developing a student typology to examine the effectiveness of first-year seminars. *Journal of the First-Year Experience & Students in Transition, 20*(2), 65-90.
- Wentzel, K. R. (1997). Student motivation in middle school: The role of perceived pedagogical caring. *Journal of Educational Psychology, 89*(3), 411-419. doi:10.1037/0022-0663.89.3.411
- Wentzel, K. R. (2002). Are effective teachers like good parents? Teaching styles and student adjustment in early adolescence. *Child Development, 73*(1), 287-301. doi:10.1111/1467-8624.00406
- Wentzel, K. R., Battle, A., Russell, S. L., & Looney, L. B. (2010). Social supports from teachers and peers as predictors of academic and social motivation. *Contemporary Educational Psychology, 35*, 193-202. doi:10.1016/j.cedpsych.2010.03.002
- White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review, 66*(5), 297-333. doi:10.1037/h0040934

Wigfield, A., Cambria, J., & Eccles, J. S. (2012). Motivation in education. In R. M. Ryan (Ed.),

The Oxford handbook of human motivation (pp. 463-478). New York, NY: Oxford University Press.

Wigfield, A., & Eccles, J. S. (1992). The development of achievement task values: A theoretical analysis. *Developmental Review*, 12, 265-310. doi:10.1016/0273-2297(92)90011-P

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, 25(1), 68-81. doi:10.1006/ceps.1999.1015

Wigfield, A., Eccles, J. S., Schiefele, U., Roeser, R. W., & Davis-Kean, P. (2006). Development of achievement motivation. In N. Eisenberg (Ed.), *Handbook of child psychology* (Vol.3, pp. 933-1002). New York, NY: John Wiley.

Wormington, S. V., Corpus, J. H., & Anderson, K. G. (2012). A person-centered investigation of academic motivation and its correlates in high school. *Learning and Individual Differences*, 22, 429-438. doi:10.1016/j.lindif.2012.03.004

Yeager, D. S., & Dweck, C. S. (2012). Mindsets that promote resilience: When students believe that personal characteristics can be developed. *Educational Psychologist*, 47(4), 302-314. doi:10.1080/00461520.2012.722805

Zimmerman, B. J., & Schunk, D. H. (2003). Albert Bandura: The scholar and his contributions to educational psychology. In B. J. Zimmerman & D. H. Schunk (Eds.), *Educational psychology: A century of contributions* (pp. 431-458). New York, NY: Routledge.

Appendix

Full Measure

Note: Measures and items were in random order on the administered survey. Below, the items are organized by measure. Most items were measured on the same scale: 1 (*strongly disagree*) to 6 (*strongly agree*), with two exceptions, which are indicated below (science competence beliefs, estimated grade in science class).

Science interest value

- In general, I find science to be very interesting
- I like science very much.

Science attainment value

- Doing well in science is very important to me.
- Success in science is very valuable to me.
- Being good at science is an important part of who I am.
- It matters to me how well I do in science.

Science utility value

- I believe that science topics are important for my future.
- In general, science is useful to me.
- What I learn in science applies to my life.

Science competence beliefs

- How good at science are you? (1 = *not at all good*, 6 = *very good*)
- If you were to list all of the students in your class from worst to best in science, where would you put yourself? (1 = *one of the worst*, 6 = *one of the best*)
- How have you been doing in science this year? (1 = *very poorly*, 6 = *very well*)

Effort in science class

- I try very hard in science class.
- I put a lot of effort into my science class.
- It is important to me to do well in science class.
- I put a lot of energy into science class.

Estimated grade in science class

- What is your BEST estimate as to your current grade in your SCIENCE class this year?
($10 = A+$, $9 = A$, $8 = A-$, . . . $1 = \text{below } C$)

Music Model of Academic Motivation Inventory (MMAMI)

Empowerment

- I have choices in what I am allowed to do in science class.
- I have options in how to achieve the goals in science class.
- I have control over how I learn the content in science class.
- I have the freedom to complete my science class work in my own way.

Usefulness

- In general, science class work is useful to me.
- The knowledge I gain in science class is important for my future.
- I find science class work to be relevant to my future.

Success

- I am capable of getting a high grade in science class.
- During science class, I feel that I can be successful on the class work.
- I am confident that I can succeed in science class work.
- I feel that I can be successful in meeting the academic challenges in science class.

Interest (situational)

- The science class work is interesting to me.
- I enjoy completing science class work.
- The science class work holds my attention.

Caring

- My science teacher cares about how well I do in science class.
- My science teacher is willing to assist me if I need help in science class.
- My science teacher is friendly.
- My science teacher is respectful of me.

Chapter 4: Conclusions and Future Directions

The overall objectives of this dissertation were to develop integrative perspectives of several aspects of academic motivation. Rarely have researchers and theorists examined a fairly comprehensive model of academic motivation that pools multiple constructs that interact in a complex and dynamic fashion (Kaplan, Katz, & Flum, 2012, 2014; Turner, Christensen, Kackar-Cam, Trucano, & Fulmer, 2014; Turner & Meyer, 2000). The more common trend in motivation research and theory has been to identify and explain only a few motivation constructs and their linear relationships rather than a more complex stance involving “continuously emerging systems of dynamically interrelated components” (Kaplan et al., 2014, para. 4) influenced by context, which has gained some recent traction (e.g., Kaplan et al., 2012, 2014; Kirschner, 2014; Turner et al., 2014; Walker, Pressick-Kilborn, Arnold, & Sainsbury, 2004).

In this dissertation, we examined more integrative perspectives of academic motivation by studying varying characterizations of a single motivation construct and related constructs, as well as interactions among multiple constructs. In the first manuscript, a theoretical review paper, we summarized multiple perspectives of autonomy in academic motivation specifically focused on providing a more integrative review and extrapolating practical teaching implications. For the second manuscript, we empirically investigated students’ motivation in class as a complex, dynamic, and context-bound phenomenon that incorporates multiple motivation constructs and perspectives. Using cluster analysis, a person-centered methodological approach, we studied academic motivation in the context of science class specifically and analyzed the findings to recommend teaching implications.

Manuscript 1: The Role of Autonomy in Academic Motivation: Conceptualizing Varying Perspectives, Theories, and Evidence

The purpose of the first manuscript (described in Chapter 2) was to identify and compare several autonomy-related constructs and explain the associated teaching implications. We reviewed several perspectives to develop a more integrative view of the need for autonomy and related constructs, focusing primarily on autonomy in self-determination theory, the concept of autonomy support, and the notion of choice. Not only has autonomy been defined differently, there are several similar motivation constructs to consider. In addition, the concept of autonomy support includes five interpersonal behaviors that are intended to meet students' needs for autonomy; however, these conditions also support motivational resources beyond autonomy (Reeve, 2009). Finally, choice, although sometimes considered one of the more obvious ways to support autonomy (Pattal, Cooper, & Wynn, 2010), has been studied very differently and researchers and theorists posit conflicting accounts of its significance and effectiveness (e.g., Reeve, Nix, & Hamm, 2003).

In addition to our focus on extracting teaching implications throughout the manuscript, we offered several recommendations for both instructors and researchers. In particular, we recommended that instructors view the elements of an autonomy supportive style as interactive in nature. We emphasized that the key appears to be supporting many motivational resources, rather than narrowly targeting autonomy. In the end, we suggested that teachers view these motivational resources as supporting one another, reciprocally, and to endeavor to actively facilitate multiple motivation resources. We similarly proposed that researchers should examine autonomy as a complex construct that can impact motivation in a multifaceted fashion, and to consider the potential for dynamic relationships with other motivation constructs. Moreover, because of the

varying definitions of autonomy, we suggested that researchers clearly define their use of autonomy and how it is measured, and not confuse “autonomy” with “autonomy support.”

Manuscript 2: Identifying Motivation Profiles of Students in Science Class

To investigate a more integrative view of academic motivation, we completed a cluster analysis to examine dynamic and complex patterns in upper elementary and middle grades students’ motivation for science class at low-income, rural schools in Southwest Virginia. Our research questions for the second manuscript (described in Chapter 3) were: (1) Can students’ science class perceptions be used to categorize students into groups with similar motivation profiles? (2) If different student motivation profiles can be identified, do the profiles relate to other important motivational beliefs and academic outcomes? We used cluster analysis to investigate fifth- through seventh-grade students’ perceptions of the amount of empowerment, usefulness, success, interest, and caring in science class to determine if the students grouped into meaningful “motivation profiles.” We tested the stability of the cluster solution by completing cluster analyses across three years, three grade levels, and one test including all cases. Then, we tested the predictive validity of the profiles by examining relationships between the profiles and (a) science attainment value, (b) science interest value, (c) science utility value, (d) science ability beliefs, (d) effort in science class, and (e) estimated grade in science class. Next, we described each profile, including relationships with students’ motivational beliefs and outcomes, and then concluded with directions for future research and limitations of the study.

Patterns of students’ science class perceptions formed five stable clusters, which are theoretically meaningful and depict students’ multidimensional motivation profiles. Cluster 1, the low motivation profile, includes students who reported a lower quantity of motivation for science class than students in the other clusters. Cluster 3, the somewhat high motivation profile,

includes students with more moderate perceptions of the constructs. Cluster 5, the high motivation profile, comprises students who generally reported a higher quantity of motivation-related perceptions. In Clusters 2 and 4, motivation profiles were more varied. Cluster 2, the low value and high support profile, includes students who reported that they held low values and had little control over their learning in science class, but expected to be successful and felt cared for. Cluster 4, the somewhat high empowerment and values, and high support profile, incorporated students who perceived a somewhat high amount of empowerment, moderate to high perceptions of usefulness and interest, and expected to be very successful and perceived a high level of caring. Most students were classified into Clusters 4 and 5 (from 55% to 63%). The profiles aligned with students' motivation beliefs and outcomes. Our findings suggest that perceived caring and expectancies for success are indicative of immediate achievement in class, even when values for science and science class are scarce and little empowerment is perceived. As values increased, performance followed. However, to achieve the highest motivation profile, highly positive values for science and science class, and perceived autonomy in class, were evident.

Our findings suggest that these motivation profiles may be context-dependent, as students rarely retained the same profiles between years. Although future research is needed to understand why students did not often maintain the same profile across years, this finding may support the notion that motivation-related perceptions often depend on the specific context of each class, which can be influenced by teachers and the educational environment (e.g., Dotterer & Lowe, 2011; Wang & Eccles, 2013). Thus, these findings study may underscore the importance of teachers' behaviors and instructional decisions in affecting student motivation in science classes.

In the end, we identified several motivation profiles that illustrate complex patterns in students' motivation-related perceptions in science class. Furthermore, the five profiles formed

consistent patterns in students' self-reported effort and achievement in science class, and aligned with theoretically and empirically correlated variables. Our intention was that the findings of this investigation might help educators target students with similar motivation profiles rather than adhere to the difficult and often unrealistic task of catering to each student's complex needs individually.

Connecting the Manuscripts

Together, these manuscripts offer more integrative views of academic motivation. In the first manuscript (Chapter 2), we examined multiple perspectives of the need for autonomy and related constructs, and developed an integrative review. In the second manuscript (Chapter 3), we studied patterns in students' perceptions of multiple motivation constructs. This research aligns with several calls for more integrative views of academic motivation in which complex, dynamic, and multidimensional systems are considered (e.g., Bergman, 2001; Jones, 2009; Kaplan et al., 2012, 2014; Turner et al., 2014), as well as multiple definitions and conceptions of constructs (Kaplan et al., 2012). Furthermore, both manuscripts suggest the importance of instructors supporting multiple motivation resources and the usefulness of the MUSIC Model of Academic Motivation (Jones, 2009) as a conceptual framework that can be used to organize related constructs.

Furthermore, we analyzed findings in Manuscript 2 that relate specifically to the self-determination theory perspective of autonomy presented in Manuscript 1. Discriminant analysis indicated that perceived empowerment was not a major influence in determining cluster membership, which seems to conflict with some arguments that meeting the need for autonomy is particularly important to high quality motivation. However, we measured quantity of motivation with the MMAMI (i.e., the amount of control and freedom students felt they had in

science class) rather than quality. In Manuscript 1, we explained that the significance of autonomy focuses on the concept of higher *quality* motivation (e.g., Vansteenkiste, Lens, & Deci, 2006), which, according the self-determination theory perspective, is considered more autonomous or, in other words, volitional, valued, and endorsed by the sense of self (Deci & Ryan, 2012; Vansteenkiste et al., 2006). Students identified as part of Cluster 5 in Manuscript 2, which would be the profile most indicative of a high quality motivation profile, reported the most perceived empowerment in class. These students not only reported a high amount of perceived control in their classes—unlike all other profiles—but also reported the most interest, attainment, and utility values for science, the highest effort in class, and the highest science class grades. Furthermore, our measure of perceived interest in science class is very similar to some measures of intrinsic motivation (e.g., Reeve, 1989), which may suggest that students in Cluster 5 not only reported a higher quantity of empowerment but also were more autonomously motivated and, in turn, experienced higher quality motivation.

Theoretical Implications

We concluded Manuscript 1 by recommending that teachers should view motivation more broadly and, rather than focus narrowly on a single construct, they can support multiple motivation resources such that they might facilitate and influence one another, reciprocally. Similarly, we posit that our findings in Manuscript 2 offer five broader motivation profiles that could be used to more efficiently design instruction targeting a more integrative perspective of academic motivation. We suggest several theoretical implications for science teachers that are specific to each profile and based on trends and patterns in the data as well as motivation theory. These theoretical recommendations were developed after examining the findings of Manuscript 2 as well as the information reviewed in Manuscript 1. Our focus was on potential first steps for

teachers from the lens of these two studies. These implications should be interpreted within the context of the assessed schools and students.

In general, we posit that supporting students on all five components of the MUSIC model will be most beneficial in encouraging their motivation and engagement (see Jones, 2009, and the Conceptual Framework section of Manuscript 2/Chapter 3). However, it may be more practical for teachers to initially focus on specific constructs in each profile, as we describe next.

In supporting motivation for students in Cluster 1, the obvious conclusion might be that they would benefit from support on all dimensions. However, analysis of the remaining four clusters suggests that students who feel that they can be successful in class and believe their teachers are caring are more likely to perform well, which is also evidenced in prior studies (e.g., Meece, Wigfield, & Eccles, 1990). In addition, teachers tend to communicate less caring to disengaged students, which may further undermine motivation (Skinner & Belmont, 1993). We recommend a preliminary focus on supporting students' success beliefs and fostering a caring environment to facilitate achievement. However, encouraging students' values for science and science class, and offering structured opportunities for autonomy, are not to be neglected. As students with low perceived competence can respond more negatively to provision of autonomy, teachers should ensure that opportunities for empowerment are structured, support confidence perceptions, and target interests (Katz & Assor, 2007; Patall, Sylvester, & Han, 2014). Lower-achieving students are less likely to respond positively to classroom interventions designed to improve engagement and motivation (Dotterer & Lowe, 2011), and so additional care should be taken with these students.

Although students in Cluster 2 were in some ways analogous to the more highly motivated students in Cluster 4, the Cluster 2 students' values for science and science class were lower, and

they expected to be less successful and estimated somewhat lower grades. These students would likely benefit from teachers addressing their science values by stimulating interest and indicating the utility of learning tasks in class (e.g., relating course topics and activities to students' everyday lives and goals).

Students in Cluster 3 held somewhat high motivation-related perceptions. Nevertheless, they reported similar grades to the low motivation profile. We propose that Cluster 3 students may benefit from teachers actively supporting their expectancies for success (e.g., facilitating positive self-efficacy for tasks, communicating clear expectations) and positive relationships and interactions within the classroom (e.g., communicating care and concern for students' academic successes and general well-being).

The Cluster 4 profile differed from Cluster 5 in that the Cluster 4 students believed they had less control over their learning and reported only somewhat high values for science and science class. However, they indicated that success in science was similarly important and, accordingly, performed quite well and put forth effort in class. To enliven even more positive motivation and encourage their persistence in science, teachers can concentrate on encouraging perceived values using methods akin those suggested for Cluster 2, as well as incorporating some provision of empowerment into the classroom structure. Because these students reported higher expectancy, they may be prepared for and desire more control than Cluster 2 (Pattal et al., 2014; Tai, Sadler, & Maltese, 2007).

Students in Cluster 5 represent the highest quantity motivation group; however, they, too, can be supported in developing even greater motivation. Students who perform well and hold high values often respond well to and often crave autonomy (Tai et al., 2007). In addition, their elevated values can be nurtured further such that they develop more lasting persistence in

science, in and outside of school (Deci & Ryan, 2000; Hidi & Renninger, 2006), and increasingly identify with the field (Osborne & Jones, 2011).

Key Points

Together, these studies represent a focus on more integrative and person-centered approaches to studying and understanding academic motivation. Two key points emerged: First, it appears to be beneficial to pursue a more integrative perspective of academic motivation in which multiple theories and constructs are pooled and students' motivation is examined as a complex and dynamic phenomena. Both studies suggest that students' academic motivation is multifaceted, and that linear methods and perspectives that are limited to single theories or constructs may not achieve as full a perspective as academic motivation likely merits. Second, this more inclusive, integrative lens further helped to explain and understand our findings, and to extract teaching implications. Not only did it appear important to approach our studies from an integrative perspective but it was import to maintain that lens when interpreting the results and describing possible teaching implications.

Future Research

There are several directions for research that could further the type of more integrative and person-centered approaches examined in these current manuscripts. First, because cluster analysis does not lend itself well to wider generalizations, it is important to continue studying this integrative perspective in multiple samples, such as at different schools; in urban, suburban, and rural areas; with high-, middle-, and low-income students; with different levels of students (e.g., elementary, secondary, post secondary); and in different fields (e.g., mathematics, language arts). Moving forward, it will be important to determine if these five clusters are consistent across groups and fields or if they specifically relate to the population measured. Along these lines, it would be

interesting to learn whether or not autonomy is a significant variable in discriminate analyses in different cluster analyses.

Additional integrative reviews of related motivation may significantly contribute to the field. The MUSIC model could be used as a conceptual framework such that integrative reviews of constructs similar to usefulness success, interest, and caring are completed.

Finally, researchers often examine autonomy by studying an amount or quantity of perceived autonomy (e.g., Patall, Dent, Oyer, & Wynn, 2013; Reeve, Jang, Carrell, Jeon, & Barch, 2004; Vallerand, Fortier, & Guay, 1997), as in our Manuscript 2. Fewer researchers have examined students' preference or desire for autonomy at the same time. Thus, it is unclear whether satisfaction with the perceived amount of autonomy is an important variable to consider when examining motivation constructs. Very recently, Amoura, Berjot, Gillet, and Altinas (2014) conducted a cluster analysis examining students' preferences for autonomy and the amount of perceived autonomy, which is the only study of its kind we have been able to locate. Their objective was to study the incongruity between students' perceptions of control and desire for control in influencing autonomous motivation (Amoura et al., 2014). However, their cluster analysis was limited to two variables: perceived control and desire for control. This very recent publication suggests a need area that could be further investigated using person-centered approaches and a variety of motivation-related variables.

References

- Amoura, C., Berjot, S., Gillet, N., & Altinas, E. (2014). Desire for control, perception of control: Their impact on autonomous motivation and psychological adjustment. *Motivation and Emotion*, 38, 323-335. doi:10.1007/s11031-013-9379-9
- Bergman, L. R. (2001). A person approach in research on adolescence: Some methodological challenges. *Journal of Adolescent Research*, 16, 28-53. doi:10.1177/0743558401161004
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227-268. doi:10.1207/S15327965PLI1104_01
- Deci, E. L., & Ryan, R. M. (2012). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 85-107). New York, NY: Oxford University Press.
- Dotterer, A. M., & Lowe, K. (2011). Classroom context, school engagement, and academic achievement in early adolescence. *Journal of Youth and Adolescence*. 40(12), 1649-1660. doi:10.1007/s10964-011-9647-5
- Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, 41(2), 111-127. doi:10.1207/s15326985ep4102_4
- Jones, B. D. (2009). Motivating students to engage in learning: The MUSIC model of academic motivation. *International Journal of Teaching and Learning in Higher Education*, 21(2), 272-285. Retrieved from <http://www.isetl.org/ijtlhe/pdf/IJTLHE774.pdf>

Jones, B. D., & Skaggs, G. E. (in press). Measuring students' motivation: Development of and validity evidence for the MUSIC Model of Academic Motivation Inventory.

International Journal of Educational and Psychological Assessment.

Kaplan, A., Katz, I., & Flum, H. (2012). Motivation theory in educational practice: Knowledge claims, challenges, and future directions. In K. R. Harris, S. G. Graham, & T. Urdan (Eds.), *APA educational psychology handbook: Individual differences, cultural considerations, and contextual factors in educational psychology* (Vol. 2, pp. 165-194). Washington, DC: American Psychological Association.

Kaplan, A., Katz, I., & Flum, H. (2014, April). Practice-relevant motivational research: Do we need a different approach? In L. Corno (Chair), *Practice-relevant motivational research: Do we need a different approach?* Symposium conducted at the annual meeting of the American Educational Research Association, Philadelphia, PA.

Katz, I., & Assor, A. (2007). When choice motivates and when it does not. *Educational Psychology Review*, 19(4), 429-442. doi:10.1007/s10648-006-9027-y

Kirschner, P. A. (2014). Editorial: When a paradigm becomes a paradigm. *Journal of Computer Assisted Learning*, 30, 297-299. doi:10.1111/jcal.12074

Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its consequences for young adolescents' course enrollment intentions and performances in mathematics. *Journal of Educational Psychology*, 82(1), 60-70. doi:10.1037/0022-0663.82.1.60

Osborne, J. W., & Jones, B. D. (2011). Identification with academics and motivation to achieve in school: How the structure of the self influences academic outcomes. *Educational Psychology Review*, 23(1), 131-158. doi:10.1007/s10648-011-9151-1

Patall, E. A., Cooper, H., & Wynn, S. R. (2010). The effectiveness and relative importance of choice in the classroom. *Journal of Educational Psychology*, 102(4), 896-915.
doi:10.1037/a0019545

Patall, E. A., Dent, A. L., Oyer, M., & Wynn, S. R. (2013). Student autonomy and course value: The unique and cumulative roles of various teacher practices. *Motivation and Emotion*, 37(1), 14-32. doi:10.1007/s11031-012-9305-6

Patall, E. A., Sylvester, B. J., & Han, C.-W. (2014). The role of competence in the effects of choice on motivation. *Journal of Experimental Social Psychology*, 50(1), 27-44.
doi:10.1016/j.jesp.2013.09.002

Reeve, J. (1989). The interest-enjoyment distinction in intrinsic motivation. *Motivation and Emotion*, 13(2), 83-103. doi:10.1007/BF00992956

Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist*, 44(3), 159-175.
doi:10.1080/00461520903028990

Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and Emotion*, 28(2), 147-169.
doi:10.1023/B:MOEM.0000032312.95499.6f

Reeve, J., Nix, G., & Hamm, D. (2003). Testing models of the experience of self-determination in intrinsic motivation and the conundrum of choice. *Journal of Educational Psychology*, 95(2), 375-392. doi:10.1037/0022-0663.95.2.375

Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology*, 85(4), 571-581. doi:10.1037/0022-0663.85.4.571

Tai, R. H., Sadler, P. M., & Maltese, A. V. (2007). A study of the association of autonomy and achievement on performance. *Science Educator*, 16(1), 22-28.

Turner, J. C., Christensen, A., Kackar-Cam, H. Z., Trucano, M., & Fulmer, S. M. (2014).

Enhancing students' engagement: Report of a 3-year intervention with middle school teachers. *American Educational Research Journal*, 51(6), 1195-1226.

doi:10.3102/0002831214532515

Turner, J. C., & Meyer, D. K. (2000). Studying and understanding the instructional contexts of classrooms: Using our past to forge our future. *Educational Psychologist*, 35(2), 69-85.

doi:10.1207/S15326985EP3502_2

Vallerand, R. J., Fortier, M. S., & Guay, F. (1997). Self-determination and persistence in a real-life setting: Toward a motivational model of high school dropout. *Journal of Personality and Social Psychology*, 72(5), 1161-1176. doi:10.1037/0022-3514.72.5.1161

Vansteenkiste, M., Lens, W., & Deci, E. L. (2006). Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation.

Educational Psychologist, 41(1), 19-31. doi:10.1207/s15326985ep4101_4

Walker, R. A., Pressick-Kilborn, K., Arnold, L. S., & Sainsbury, E. J. (2004). Investigating motivation in context: Developing sociocultural perspectives. *European Psychologist*, 9(4), 245-256. doi:10.1027/1016-9040.9.4.245

Wang, M.-T., & Eccles, J. S. (2013). School context, achievement motivation, and academic engagement: A longitudinal study of school engagement using a multidimensional perspective. *Learning and Instruction*, 28, 12-23. doi:10.1016/j.learninstruc.2013.04.002