


Investigating a Quantitative Measure of Student Self-authorship for Undergraduate Medical Education

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ABSTRACT

CONSTRUCT: In this study, the authors investigated the validity of a quantitative measure of self-authorship among medical students. Self-authorship is a cognitive-structural theory incorporating the ability to define one's beliefs, identity, and social relations to operate in a complex, ambiguous environment.

BACKGROUND: Competency-based medical education (CBME) provides learners with the opportunity to self-direct their education at an appropriate pace to develop and exhibit required behaviors while incorporating functioning relationships with supervisors and trainers. Students must develop skills to adjust and succeed in this educational climate. Self-authorship is a theoretical lens that is relevant to identifying the development of the skills necessary to succeed in a CBME curriculum. Understanding the level of attained self-authorship by medical students can provide important information about which professional characteristics are more prevalent among those who are more self-authored and about how students succeed in medical school. Although there are calls in the extant literature for the application of self-authorship in medical education, there is no quantitative measure to assess its development among medical students.

APPROACH: The authors developed a survey to measure self-authorship, including a free text question regarding the thought process around a hypothetical ethical situation during training. Data were collected in 2014 and 2015 from undergraduate medical students and analyzed using factor analysis and qualitative analysis of the free text. Validity evidence was sought regarding content, internal structure, and relationships to other variables.

RESULTS: Analysis supports the use of a 22-item instrument to assess 3 constructs of self-authorship: asserting independence and autonomy, knowledge processing, and sense of self in ethical situations. Content analysis of text responses supported the ability of the instrument to separate development, or a lack thereof, of self-authorship.

CONCLUSIONS: The authors identified an instrument that measures multidimensional, higher-order characteristics that intersect with self-authorship. This instrument can be useful at a macro level for curricular and student assessment of self-authorship. Development of these characteristics can help foster success in a CBME environment and support curricular efforts in this regard. Understanding a student's level of self-authorship can help identify areas for support as well as allow for comparisons of different student characteristics.

KEYWORDS: undergraduate medical education, self-authorship, validation, survey research, qualitative study

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Introduction

Medical education is in the midst of a transformation from the time-bound concepts of didactics and clinical experiences to a competency-based system that instead uses performance outcomes to measure trainees' progress outside of a time-constricted model.^{1,2} Competency-based medical education (CBME) provides the learner with the opportunity to self-direct their education at an appropriate pace to develop and exhibit required behaviors while incorporating functioning relationships with supervisors and trainers.² Key elements of CBME include active observation by educators, the provision

of specific formative feedback, and subsequent reflective incorporation of this information by the learner. Students, in response, must develop sufficient skills to adjust and succeed in this educational climate.

Most significantly, "Learners in an OBME [Outcomes-based medical education] must be active agents co-guiding both their curricular experiences and assessment activities."^{2(p1217)} This active participation requires that students have the capacity not only to gather knowledge and feedback but also to be able to process and incorporate the information to grow and improve. A recent survey of Internal Medicine residents found



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that the skill residents most wish to have developed for internship was identifying when to seek additional help and expertise.³ Having the capacity to independently reflect and monitor deficits is critical to succeed in a system of CBME.

Self-authorship provides a useful theoretical lens to study the development of medical students as it applies to performance in a CBME environment. As originally defined by Robert Kegan and refined by Marcia Baxter Magolda, self-authorship falls within the cognitive-structural theories of development that explain how individuals question and interpret experiences as they build a sense of self and relations with others.⁴ In particular, it describes “the internal capacity to define one’s beliefs, identity, and social relations”^{5(p269)} and seeks to explain how a person is able to consider external influences and persevere in a complex, ambiguous environment. While Kegan theorized development along the full life span, the work by Baxter Magolda⁵ focuses on adult development, in particular starting at college age. Three dimensions of personal development have been posited: epistemological, intrapersonal, and interpersonal. The epistemological dimension refers primarily to how a person acquires knowledge amid ambiguity and conflicting information and reflects on the extent of their cognitive maturity. The intrapersonal dimension refers to one’s values and beliefs and how they evolve to become self-defined and incorporated into decision-making and foster identity integration. Similarly, the interpersonal dimension identifies how one relates to others and speaks to the maturity of relationships. These 3 elements are intertwined and equally important in the development of self-authorship.

Baxter Magolda⁵ identifies 3 sequential phases in the development toward self-authorship. Starting in the External Formulas phase, an individual bases decisions, actions, and values/beliefs on the influence and knowledge provided by authority figures. Moving to the Crossroads phase, he is faced with information/situations that draw into question previously held knowledge or beliefs, yet is unsure how to resolve these conflicts. Still, within this phase, one is able to reflect and understand that personal change may be necessary. By the Early Self-authorship phase, the individual understands and can reconcile his own beliefs and knowledge with external influences. Subsequent decisions can then be made by taking into account his own values and beliefs and working with others to achieve mutually beneficial goals. Development of the 3 dimensions through these phases does not necessarily occur equally; it is also possible for some dimension(s) to regress while others progress at a given time.⁶

The application of self-authorship to the study of personal and professional development within medical education has emerged in the literature and is especially relevant within the context of CBME.^{7,8} Some have expressed concerns that CBME is too reductionist, may not fully apply to the higher-order thinking and practice required of medical professionals, and actually may risk “teaching to the test” by excessive focus

on specific competencies to the exclusion of other outcomes.⁹ As such, traditional educational models based on knowledge acquisition and global ratings may yet also have a place in medical education. And, to the extent that critics of CBME are correct, then the more synthetic and conceptual framework of traditional medical educational approaches can readily be seen to call upon the learner to be an active agent in their education whose success in so doing depends upon the evolution of their self-authorship. Indeed, to the extent that development of a professional identity constitutes a major thread of medical education, becoming self-authored likely encompasses intangible learning that spans curricular approaches.¹⁰ Altogether, regardless of its fidelity to CMBE, the trajectory of medical education can be linked with self-authorship’s 3 dimensions (ie, cognitive maturity, an integrated identity, and the ability to maintain mature relationships).⁷

First, the journey through medical education from classroom to the clinical wards to residency requires the individual to model and acquire new roles as one progresses through training. A person who is self-authored understands their personal approach to navigating multiple roles and is better equipped to identify how these cohere or conflict.¹¹ Second, medical education is an experiential process dependent on relationships with instructors with different levels of authority. Learning from multiple individuals as well as seeking out and reflecting upon feedback are key to progression through the medical curriculum, whether CBME based or otherwise. The ability to reconcile all of this information within the clinical context while acknowledging one’s personal values and beliefs may be better achieved by those who are more self-authored.⁸ Finally, the influence of the physician-teacher is significant to both knowledge and identity formation as the student develops into a physician.^{12,13} The centrality of the teacher-student relationship within medical education highlights the importance of being self-authored. Teachers provide knowledge and model behaviors in the clinical setting that students see and emulate. The behaviors they see can often conflict with their own values and understanding of expected behavior. A self-authored person is better able to evaluate these behaviors and then navigate through and balance them with their own values and beliefs.

Arguments have been made for widening medical education beyond clinical competencies to incorporate identity formation, calling for a systematic measure of self-authorship to support these specific changes to the curriculum.⁷ Identifying the level of attained self-authorship of medical students can provide important information to understand how students succeed in medical school and which professional characteristics are more prevalent among those who are more self-authored.

Previous studies of self-authorship have predominantly used qualitative interviews, which can be time-intensive and require skilled interviewers.¹⁴ Very few quantitative tools have been developed to measure self-authorship, none of which have been

applied to medical education.¹⁵⁻¹⁷ These tools do not replace qualitative interviews in providing in-depth measurement of self-authorship among individuals but instead conveniently measure the concept among groups of individuals. Challenges faced by these researchers have included writing questions that focus on the thought process involved in decisions/actions as opposed to the actual decision/action, as well as collecting qualitative information that can be used to correlate with these items. Although a battery of written questions has the potential for respondents to identify desirable response patterns, it has also been shown that there can be a similar bias among interviews.⁶ Clearly written questions that avoid signals toward desired responses and thoughtful ordering of questions can help to reduce this potential in a written survey.¹⁸ The development of the 3 dimensions of self-authorship is an intertwined process.⁶ Previous studies to identify an instrument have also identified different underlying structures, representing the distinct dimensions of self-authorship or multidimensional aspects.^{15,19}

Given the potential value of self-authorship to the study, education, and nurturance of medical students, we sought to develop and validate a quantitative instrument relevant to this population. We did not hypothesize an expected structure to the instrument given the variability in prior findings and the different population in our study.

Methods

Current models of validity recommend evidence in 5 categories: content, response process, internal structure, relationship to other variables, and consequences.²⁰ We sought evidence in 3 of the categories—content, internal structure, and relationship to other variables. Response process was not investigated beyond manual verification of the data entry process; evidence of the consequences was excluded because we have not yet prospectively applied the instrument in an educational setting, nor is the intent to use this in a high-stakes context.

Content validation

The basis for the development of our instrument was the work by Creamer et al.¹⁵ After telephonic consultations with Creamer, we used a matrix of the 3 dimensions and phases of self-authorship to align the original 18 items from the Creamer scale to a cell; we found that some cells included only 1 to 2 items. As we were seeking to develop a scale for a new population, we included a larger number of items indicative of each cell to more fully represent each of the categories within the matrix and to improve the potential for the identification of a latent structure.²¹ In all, we created another 26 items, for a total of 44. Following Creamer's methods, we tagged all new items to a specific phase and dimension of self-authorship, which could be used to aid in the interpretation of subsequent factors. This categorization was not identified to the respondent in the actual survey questionnaire.

The original instrument focused on career choice; based on the experience of the physician-teachers on the research team, we recontextualized the items in Creamer's scale around choice of medical specialty or aspects of medical education. The items were worded to relate to the process behind decisions/actions and not the actual decisions/action. All items were rated on a 4-point Likert scale of strongly agree, agree, disagree, strongly disagree.

We also included a free text item to gather information regarding the student's thought process as a potential corroborating measure. Typically, a trained interviewer will direct a conversation by stating, "Help me understand that experience . . ." when exploring self-authorship.¹⁴ To emulate this process, we included an open-ended question asking for each student's thought process when posed with a dilemma between a student and a faculty member who was involved in evaluating their performance—specifically, the student was asked what they would do if they witnessed a supervising faculty member say something derogatory about an overweight patient while they were under sedation. Prior research has been inconclusive on using this approach given the data, or lack thereof, that respondents include in their text, yet this is still viewed as a potential corroborating source of information.¹⁷

Subsequently, we conducted a pretest with a group of graduating students and interviewed them afterward to determine the clarity and focus of the items. Before the pretest, the project was described to these students in relation to student development generally; during the discussion afterward, we specifically explained its relation to self-authorship. Minor wording changes to some items were made based on this feedback.

Internal structure validation

We used exploratory factor analysis with the maximum likelihood method to identify the underlying structure of the items.²² Rotation of the component structure often provides clarity to interpretation of the components. We tested both orthogonal and oblique rotation methods. Should correlation among the factors not be significant ($<.32$), we would use an orthogonal rotation.^{22,23} We followed guidelines for selecting factors with an eigenvalue >1 in conjunction with a review of the Cattell scree plot.²² We used a cutoff of 0.30 for the identification of variables and interpretation of the factors.²⁴

Subsequent to the identification of factors, a total score was calculated for each student. It is difficult to identify distinct steps along the range of scores to clearly separate a particular phase of self-authorship. Extreme Groups analysis is a method that specifically uses distinct ends of a distribution of scores for statistical comparisons representative of the full spectrum. Given the lack of specificity in moving from one phase of self-authorship to another, we used an approach similar to an Extreme Groups analysis to identify extremes only for qualitative analysis and not the statistical calculations

usually associated with this technique.²⁵ Specifically, omitting the intermediary developmental stage of Crossroads, scores more than 1 SD below the mean were coded as low and scores more than 1 SD above the mean were coded as high.

Relationship with other variables validation

Content analysis of the open-ended responses was used as a method to identify a relationship to other variables. Analysis of qualitative data can help by validating, interpreting, and illustrating quantitative findings.²⁶ All comments were reviewed in a blinded fashion, except for a code to link back to the survey responses. Three faculty (R.F., B.H., C.K.) and one student (L.G.) reviewed all of the comments individually and then compared results jointly to agree on the final coding. As a research team, the experience of the faculty incorporates academia, student affairs, and patient care. This background, along with advice from Creamer during our telephonic consultations, provided a rich background to interpret the responses to the open-end question subsequent to completing the exploratory factor analysis. This included comparing and contrasting responses to identify trends and differences among the respondents.²⁷ As themes emerged in the data that evidenced either a clear thought process (or lack thereof) related to self-authorship, we created codes to identify categories of either externally driven or self-authored phases of development. The coding did not distinguish between the dimensions of self-authorship as we were only seeking to find evidence of the extremes of development, instead of forcing the responses to fit into specific dimensions of self-authorship. Once the text data were coded, we assessed the relationship between variables by assessing the respondents' qualitative coding in correspondence with whether they scored as low or high on the scale.

Participants and procedures

This study took place at a large urban medical school (approximately 550 students) in the northeast United States. The Icahn School of Medicine at Mount Sinai has a limited early assurance admission program representing approximately 25% of the enrollment.

We administered a paper-based survey to the year 1, year 2, and year 3 classes at the beginning of the 2014–2015 and 2015–2016 academic years. (Fourth-year students were excluded due to the difficulty in scheduling with the few times they met together.) All students received an e-mail about the study the night before mandatory class orientation meetings, whereupon the paper survey was distributed by students affiliated with the research team. Students who chose to participate had time to complete the survey at the end of the sessions. To ensure the response process did not introduce any bias, the students completed the surveys independently away from the presence of any of the faculty on the research team and returned them to collection boxes outside the meetings. For data entry, response

options were given numerical values: strongly disagree = 1, disagree = 2, agree = 3, and strongly agree = 4.¹⁵ Six items were reverse coded because the nature of the items would suggest disagreement as self-authorship developed. Data entry was randomly checked to monitor data quality. All analyses were conducted using SAS/STAT software Version 9.3 of the SAS System for Windows. This project was deemed exempt by the Institutional Review Board at the Icahn School of Medicine at Mount Sinai (HS 12-00543).

Results

Quantitative analysis of instrument items

Overall, 421 (55%) students completed the survey. Of these respondents, 224 (54%) were women and there were 97 (23%) who indicated they were accepted through the early assurance program. These characteristics are representative of the overall student population, which is characterized by 48% women and 25% early assurance students.

The Kaiser-Meyer-Olkin (KMO) index of sampling adequacy was 0.731 for the full sample, which is acceptable as a moderate indication of homogeneity among the sample variables and appropriateness of the data set for factor analysis.²⁸ Measurements of skewness (−0.03 to 0.68) and kurtosis (−0.07 to 1.4) were within acceptable limits for factor analysis.²² Of the 44 original items in the survey, 12 were eliminated from the model due to insignificant correlation with any other variables. Through an iterative process of exploratory factor analysis, further items were also removed, which did not load on the identified factors or, conversely, loaded at a level above 0.30 on more than one factor.²⁹

Initial factor analysis using an Oblimin oblique rotation method found low correlation among the factors, with the largest correlation being .12 between factors 1 and 3. The analysis was replicated using an orthogonal (Varimax) rotation. The same 3 factors were identified from the models using eigenvalue and scree plot criteria. The factor loadings after rotation show that 2 factors are overdetermined with at least 4 variables loading above .30 after rounding, while the third has 3 variables.³⁰

Figure 1 contains the loadings from the exploratory factor analysis. The items that cluster on the first factor suggest that it represents a measure of *asserting independence and autonomy*, reflective of items representative of all 3 dimensions of self-authorship. These items include aspects of seeking multiple inputs and incorporating information as well as asserting oneself. The items that load on the second factor suggest that it represents *knowledge processing and interpretation*, here representing 2 dimensions of self-authorship, epistemological and intrapersonal. Key to these items is the incorporation of multiple views. Items that load highly on the third factor suggest that it represents a *sense of self in ethical situations*, here more related to the interpersonal dimension of self-authorship. These items clearly relate to ethical issues within their wording and identify

<i>Asserting independence & autonomy</i>	<i>Interpreting information</i>	<i>Sense of self in ethical situation</i>	<i>h²</i>	
0.59	-0.22	0.05	0.40	When choosing a medical specialty, it is most important to seek direction from informed experts
0.59	-0.20	-0.06	0.39	When choosing a medical specialty, it is most important to acquire as much information as possible
0.51	-0.02	0.03	0.26	When choosing a medical specialty, it is most important to consider the available information along with my own views and experiences
0.46	-0.04	0.11	0.23	The most important role of an effective mentor or advisor is to challenge a student to clarify expectations (e.g. training, lifestyle) of a medical specialty
0.46	0.08	-0.17	0.25	When choosing a medical specialty, it is most important to consider my own opinions and views
0.42	-0.01	0.28	0.26	If a teacher or advisor recommended a medical specialty that I have never considered before, I would try to understand their point of view and how it would best fit my needs and interests
0.41	-0.07	-0.01	0.17	The most important role of an effective mentor or advisor is to provide guidance about a choice of specialty that is aligned with how I view my skills, talents and personality
0.40	-0.02	0.07	0.16	The most important role of an effective mentor or advisor is to direct students to information which will help them to make a decision on their own
0.36	-0.11	0.11	0.15	When people have different interpretations of a journal article, I think their ideas should be compared to determine which makes more sense to me.
0.35	-0.06	0.20	0.17	Other students can look to me for mentorship on at least some matters.
0.34	0.10	0.05	0.13	When people have different interpretations of a journal article, I think that some articles are just that way. It is possible for all interpretations to be correct.
0.34	-0.09	0.07	0.13	Experts are divided on some scientific issues, such as the causes of global warming. In a situation like this, I think it is best to accept the uncertainty and try to understand the principal arguments behind the different points of view.
0.34	0.10	-0.14	0.14	Experts are divided on some scientific issues, such as the causes of global warming. In a situation like this, I would have to look at the evidence and come to my own conclusion.
0.34	0.01	0.16	0.14	To choose a medical specialty to practice, I think that advisors or mentors can provide advice to consider along with my own ideas.
0.32	0.07	0.18	0.14	If a teacher or advisor recommended a medical specialty that I have never considered before, I would share my opinion about it
0.11	0.81	-0.09	0.67	When people have different interpretations of a journal article, only experts can say which interpretation is really correct ^a
-0.02	0.42	0.10	0.18	When people have different interpretations of a journal article, I think only one interpretation can be right. ^a
0.19	-0.36	-0.17	0.19	The most important role of an effective mentor or advisor is to be an expert on one or more medical specialties.

Figure 1. (Continued)

	0.06	-0.50	0.13	0.27	Experts are divided on some scientific issues, such as the causes of global warming. I rely on the experts to decide.
	0.15	0.00	0.70	0.51	If faced with an ethical concern in medical school. I am comfortable voicing my concern to other students.
	-0.01	0.20	0.55	0.34	If faced with an ethical concern in medical school. I am most comfortable keeping my concern to myself. ^a
	0.11	-0.11	0.48	0.25	If faced with an ethical concern in medical school. I am comfortable voicing my concern to a superior.
Eigenvalue	4.17	1.82	1.51		
% variance	53.50	23.32	19.36		
Cumulative variance		76.82	96.18		

Figure 1. Rotated factors using exploratory factor analysis with varimax rotation.

Loadings greater than or equal to 0.30 indicated in bold.

^aItem was reverse coded for data analysis.

students' feeling capable to address ethical concerns. The 3 concepts embodied by these factors represent distinct aspects of self-authorship and illustrate the way in which the dimensions of self-authorship coexist and intertwine within the factors.⁶ For example, the robustness of a student's sense of self in an ethically challenging situation should at least conceptually correlate with their level of self-authorship.

Factor-based scale scores were calculated for all respondents who had complete (nonmissing) data for all 22 identified variables. The mean score was 65.7 with an SD of 5.4 and range of 53 to 79. Following the Extreme Groups methodology and using 1 SD from the mean as a cutoff, 82 responses scored as high ($m + 1$ SD) and 53 scored as low ($m - 1$ SD).

Qualitative analysis of text responses

Overall, 339 (81%) students responded to the open-ended question in the survey. The level of detail in the responses varied widely from one sentence to several paragraphs. The content ranged from those who described some type of behavior(s) they would exhibit in response to the scenario without any indication of the thought process underlying their proposed actions to those who provided information that illustrated the internally or externally driven extremes of their thinking. When reviewing the comments prior to the factor analysis, we identified 69 comments that related to low levels of self-authorship development. These tended to fall into 2 themes: a need to be told what to do in the situation and avoidance of responding due to fears of repercussions. There are 91 comments that exhibited development of self-authorship and fall into 3 themes—expressing the need to talk to the faculty member about the situation, talking to the faculty and clearly stating the need to discuss with the faculty the student's point of view, and clearly expressing a thought process that related to the dimensions of self-authorship without necessarily stating a proposed action. Examples of the relevant comments are included in Figure 2.

To substantiate evidence in the category of "relationship to other variables," we analyzed the comments just for those students who scored "low" or "high" on the scale. There were 53 cases scored as "low" and 82 cases scored as "high" on the quantitative assessment, with 204 cases meeting neither criterion. Most (33/53 "low" and 66/82 "high") had some response to the open-ended question. Different themes were identified for the high- and low-scoring cohorts that supported their scores. Low-scoring students typically included comments that mentioned fear of consequences if they voiced a contrary belief or took action (29%), reported the intent to do nothing (26%), and reflected a need to seek out others for their opinion (25%). For example, one respondent wrote,

I have to be honest with myself and comfort level at this point that I probably would not feel comfortable speaking up and reprimanding that attending.

Similarly, another student wrote,

I do not think I would say anything because I do not feel comfortable addressing inappropriate behavior in a superior.

Some in the low-scoring cohort also indicated they would confront the faculty member, but would do so "nicely" or subversively:

I would try to establish that I was on his "team" but follow that up with a statement that suggests my discomfort.

Conversely, among those in the high-scoring cohort, the most common themes were to engage with the physician to better understand the situation (38%) and a description of their thought process in interpreting the situation (29%). Students who scored high on the self-authorship scale were much more active in their proposed responses and concerned more with the situation than the conflict with an evaluator:

Low levels of self-authorship – (External)

<i>The need to be told what to do</i>	I'd wait to ask my advisor how I should handle this.
	I would keep it confidential but ask my peers what they would do.
	I would probably talk to other people to hear their opinions on the appropriateness of the comments/what I should do/could do next.
<i>Fear of repercussions/ power dynamics</i>	Given how our grades depend on the faculty and their perception of us, I would feel stuck.
	I do not think I would say anything because I do not feel comfortable addressing inappropriate behavior in a superior.

Higher levels of self-authorship – (Early Self-authorship)

<i>Expressing the need to talk to the faculty member about the situation</i>	Recognize what seemed wrong in the encounter. Understand why. Approach faculty in a private setting and ask how s/he thought the encounter went.
	Although I agree with the faculty member, I would probably nicely question him about his insensitivity towards the patient.
	I would want to speak with the member directly to understand/clarify the reasoning behind their actions. It's always important to first engage in direct communication before bringing up the matter elsewhere.
<i>Talking to the faculty and clearly stating a need to educate the faculty on the student's point of view</i>	I would say something to the faculty member along the lines of 'we don't necessarily know all of the factors surrounding this patient's case', not directly accusing the faculty member
	The doctor is expressing frustration and maybe sadness. I would validate his/her feelings and then, if appropriate at the time, engage in some kind of discussion about how the patient got here.
	I would explain the patients correlation b/t their surgery and their weight outside of the room and never in a derogatory fashion
<i>Expressing a thought process that related to the dimensions of self-authorship without necessarily stating a proposed action</i>	I would fully consider the situation and try to understand it from different perspectives: from the perspective of the doctor, that of the patient. I would also consider the responsibilities of a doctor to the oath he/she has taken to do no harm and to maintain professionalism. While this comment is clearly unprofessional because it was derogatory to the patient, I would also consider the actual harm done. I would also try to understand how the doctor might have been feeling in that moment.

Figure 2. Illustrative quotes from themes identified in response to an open-end question.

I think it is important in medicine to never forget that our patients are human beings with feelings and emotions, like ourselves. If something about the way the doctor was treating the patient . . . I would find it necessary to say something to address the mistreatment. Obviously, I would be a little concerned about speaking out to someone who is considered my superior who is evaluating me. I would likely first ask permission to speak to the faculty member freely, and then let them know that their words made me feel uncomfortable and would likely make the patient uncomfortable.

Interestingly, this cohort also included some who would not confront the faculty member, not because of any fear of retribution but instead because they identified/empathized with the faculty member's actions and were clear in stating their beliefs regarding the issue. The following exemplifies this:

I would not address this behavior because there is some truth to the statement although it is rude and places blame on the patient. I don't think it is extreme enough to address unless the incident happens multiple times.

Discussion

This study focused on the development of an instrument to measure the construct of self-authorship among medical

students. To the best of our knowledge, this is the first instrument of its kind applied to undergraduate medical education. However, our model did not replicate the separate phases of self-authorship but instead identified higher-order characteristics.

We sought to derive evidence of validity for the scale in 3 areas. The content of the scale was supported by the previously validated instrument we used as the basis for the survey items, along with a pretest and expert review. Statistical analysis of the data substantiates the internal structure of 3 factors, which interweave dimensions of self-authorship and relate to higher-order characteristics of self-authorship. The 3 factors reflect independence and autonomy, processing information, and facing ambiguity in ethical situations, all of which embody movement toward the Early Self-authorship phase and resonate with the characteristics of CBME. This structure did not replicate the findings from Creamer et al¹⁵ with factors for each dimension; our findings were instead multidimensional. Given the exploratory approach of our research, this finding is not surprising and aligns with other research. As a proxy for determining relationships with other variables, we were able to show that there were a sufficient number of responses from the

open-end question to corroborate the separation of students into the high and low extremes of the scale. Of note, we too faced issues with the quality of the qualitative data that we had to support the construct items. Similar to prior research, some of the qualitative data did exhibit incompleteness or responses that did not answer the question fully.¹⁷ We did lose some students who may have scored high (or low) on our scale but who did not provide substantive responses to the open-ended question and could not be included in the qualitative analysis. Finally, we did not assess 2 other facets of validity: the response process, except to verify the data entry, as well as consequences because we have not yet prospectively applied the final instrument to our students.

Development of self-authorship is an individual process and can incorporate the 3 dimensions in different ways.⁶ It is not surprising then that the factors reflect a higher order of self-authorship as opposed to unique dimensions. In some part, this may be an artifact of our having posed an ethical dilemma in the vignette on which our qualitative analysis was based rather than a career decision as in the work by Baxter Magolda. But, more significantly, it may derive from the unique characteristics of medical students in relation to the baccalaureate populations in prior research. Compared with baccalaureate-level students, medical students have already traversed additional developmental steps simply by making the decision to go to medical school and participating in all of the preparation and application stages.³¹ In addition, the medical students in this study have already encountered a new challenge to their values and beliefs by having matriculated into medical school as well as potentially having taken time off between college graduation and medical school matriculation.³² They have had to acclimate to an educational setting that can be very different from their baccalaureate experience. They have also encountered a new set of teachers and mentors who may provide a very different experience in teaching methodologies and assessments, all of which can be unfamiliar and/or challenging. Some may have even faced the question of whether medical school was a correct choice or not.³² All of these possibilities provide the opportunity for students to face inner conflict and evolve toward more self-authored behavior.⁵

Self-authorship is described as a potential tool to support success in the medical education continuum.⁷ The ability to identify developmental differences in self-authorship among medical students should enhance their preparation for and education within medical school. Baxter Magolda recommends qualitative interviews to fully explore the development of self-authorship and we agree with this approach from a theoretical perspective. However, our instrument is intended to provide an accessible snapshot of a student's current stage of development within self-authorship. The scale can serve multiple purposes within the academic setting. Broadly speaking, it might help improve the undergraduate and medical school curriculum and programs to support individuals who might start medical

school at a developmental disadvantage. More specifically, it might be possible for advisors in medical schools to offer something akin to an individualized educational plan for a student whose level of self-authorship requires augmentation, providing them with resources or guidance on how to develop the self-authorship skills that can help one succeed in light of a curriculum oriented around CBME. Future research can help determine the use of such a manifestly promising approach. And, medical educators who have access to the self-authorship assessment of students may be able to use this information to help recruit upperclassmen for roles providing mentorship and role-modeling for fellow students.

Finally, the proposed scale can also provide one way to help investigate any possible differences in the professional development of medical students who matriculate through different entry paths. Our medical school has a significant early assurance program, which eliminates the MCAT and minimizes premed baccalaureate educational requirements, all of which remove the pressures of a premed baccalaureate and allow for educational and personal exploration.^{31,32} This can impact the development of self-authorship and intrapersonal development in particular. These students have been shown to perform as well as their peers on cognitive measures.³² Might they also be more, or less, prepared to succeed with a CBME program? Unfortunately, there is little extant literature on the overall benefits of early assurance programs, including ours. As Eaglen et al³³ state, "For those programs that strive to reduce competitive pressures or emphasize humanistic qualities, there have been no studies to date indicating whether students in those programs are different in any meaningful way by the time they begin medical school" (p. 5). The same question can potentially be asked of dual degree pathways such as MD/PhD or MD/MPH. This self-authorship scale can provide one way to assess developmental differences in students from matriculation through graduation.

Limitations

This study has several limitations. First, the data are limited to one medical school that has a proportionally sizable early assurance student population. The early assurance program is rather liberal in admission requirements when compared with other medical schools with early assurance programs. We also were not able to include the fourth-year students. Thus, the sample may not be representative of students in other medical schools, even those that also have early assurance programs.

A second limitation regards the methods used. Exploratory factor analysis is useful in exploring the reliability and validity of a scale. However, further research is necessary to validate the self-authorship scale through confirmatory factor analysis. Our primary plan for future research is to collect additional data to support such analyses, both from within our school and from collaborative partners. The richer data from multiple sites would improve the generalizability of the instrument, allow for

analyses of subpopulations, and support its applicability in other institutions.

Finally, we understand that the context of scientific disagreement regarding global warming is now not a proper example in the questions and would suggest future studies use a different version without a specific example, such as “Experts are divided on some scientific issues. In a situation like this, I think it is best to accept the uncertainty and try to understand the principal arguments behind the different points of view.”

Conclusions

Ultimately, this research raises the question as to whether any assessment of self-authorship among medical students needs to be more sophisticated and contextual than those instruments that have been designed for college students. Not all medical students are at a higher developmental phase of self-authorship, but the way these students approach the concept may require different methods of measurement. To better understand how medical students think about self-authorship, qualitative data should also be collected along the lines of the personal interview methods discussed by Baxter Magolda and King.¹⁴ Qualitative research involving interviews with different medical student populations (eg, early assurance and premed students; students who take gap years prior to matriculation; MD-PhD students) could provide rich information to understand how these students relate to self-authorship concepts and identify them within themselves. This research also provides the opportunity to explore the experiences each subgroup had as undergraduates. The ability to compare and contrast the students’ experiences during their undergraduate college education, including their decisions on which classes to take (externally driven vs internally driven choices), what their individual goals were in selecting classes, and how this relates to their vision of medical school (values, beliefs) could provide rich information with which to further assess and ultimately nurture self-authorship. This information could also provide background to further develop the items in the scale and better reflect how self-authorship relates to the medical student population.

White et al⁸ argued for the need to support the growth of self-authorship, specifically for medical students and trainees as they progress through the many stages of medical education and training. Programmatic attention to medical students’ and trainees’ self-authorship may have the potential to help foster identity formation and better physician-patient relationships as well as professional relationships for future physicians. A quantitative measure of self-authorship can provide a key method to validate efforts to bring self-authorship into the medical education curriculum in all medical schools.

Authors’ Note

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Author Contributions

RF, BH, NK and CK contributed to the conception of the study. RF, BH and CK were responsible for the design of the data collection instrument. RF, CK, RS and LG contributed to the data collection and entry. RF performed the statistical analysis. RF, BH, LG and CK contributed to the qualitative analysis. RF wrote the results and prepared the figures. All authors read, edited and approved the final manuscript.

Ethical Approval

This project was deemed exempt by the Institutional Review Board at the Icahn School of Medicine at Mount Sinai (HS 12-00543).

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