



A Mixed-Methods Exploration of the Developmental Trajectory of Autonomous Motivation in Graduate Medical Learners

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Abstract

Introduction Self-determination theory (SDT), when applied to curricular construction, emphasizes curiosity, self-awareness, and resilience. Physicians need these qualities to face the challenges of clinical practice. SDT offers a lens for medical educators to track learner development toward sustainable, rewarding careers. This study describes the changes observed in learner communications about feelings of competence, relatedness, and autonomy across a 3-year family medicine training program designed to develop activated, lifelong learners.

Methods This retrospective, mixed-methods case study uses a phenomenological approach to explore how 51 learners described their experiences at various intervals in residency training. Data collected from 2009 to 2015 from resident focus groups, competency assessment meetings, and faculty assessment reports inform a 3-stage analysis process to determine learner motivation levels along the SDT continuum.

Results Aggregated qualitative and quantitative data show residents' progression from introjection (controlled motivation) in PGY1, to identification (autonomous motivation) in PGY2, and integration (autonomous) by the end of PGY3. The examination of a single learner's data set reveals an advanced motivation level in PGY1 (identification), followed by a period of retrograde in PGY2 (introjection), then rebounding in PGY3 (identification), which illustrates how motivation level can be affected by external competency requirements and challenges related to career transitions.

Discussion The examination of self-motivation in medical learners has implications for curriculum development, assessment, teaching and self-directed learning, and resilience training. Learner awareness of intrinsic motivation, and the curriculum designed around it, can better prepare residents for challenges during residency and help them flourish in twenty-first-century medicine.

Keywords Clinical education · Curriculum · Graduate medical education · Instructional materials/methods · Medical education · Motivation · Primary care education · Qualitative research methods · Quantitative research methods · Self-determination theory

Background

There are challenges inherent to any medical practice. Regulatory encroachment, shifting standards of care, clinical uncertainty, increasing burnout rates, and career

dissatisfaction require attention in medical education [1, 2]. Studies of self-determination theory (SDT) have shown that intrinsic motivation in education is associated with deep learning rather than surface learning, higher academic performance, greater engagement, higher persistence, lower dropout rates, and a more positive well-being, when compared with curricula that rely on methods of extrinsic motivation [3–6]. Incorporating SDT into curriculum development emphasizes learner curiosity, self-awareness, and resilience and may better prepare the next generation of physicians to succeed and thrive in their future medical practice.

SDT provides a framework for exploring how psychological needs facilitate or impede self-motivation and healthy mental and behavioral functioning. Ryan and Deci [3], in their development of SDT, explore human behavior as

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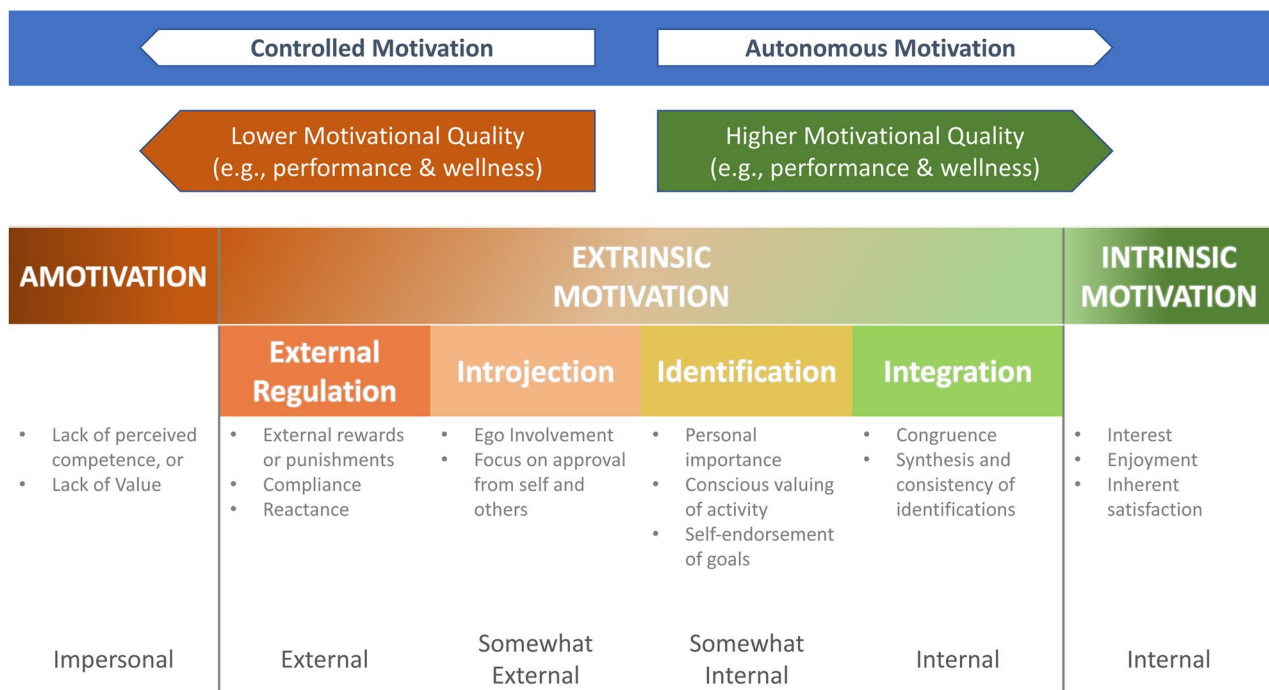
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an outcome of forces that drive one's desire to act. They categorize types of motivation along a continuum. At one end is extrinsic motivation, driven by the desire to obtain a reward or avoid loss or punishment. At the other end is intrinsic motivation, driven by personal interest or joy. This has evolved into a more nuanced model (Fig. 1) that explores whether the motivation derives from an outside entity (controlled) or from within the individual (autonomous).

Examined independently, each of the constructs of SDT—autonomy, competence, and relatedness (Fig. 2)—offers insights on learner motivation. Autonomy refers to the perception that one's experiences reflect personal choices made to achieve goals set for development of the self [4, 7]. Understanding learners' needs, recognizing educational preferences, and teaching in a learner-centered [5, 8–11] environment are integral to facilitating autonomy in a developing “master learner” [5]. A learner-centered approach, or learning-oriented teaching [12], focuses on student characteristics [6], emotions [9], and needs [13, 14]. It provides a tailored curriculum [15] and negotiated goals [16]. Competence, one of the most frequently analyzed SDT constructs in medical education, is defined as feeling effective in the actions one pursues [17] or feeling capable of mastering new material [7]. A decade-long review of competency-based medical education [18] reveals the need for new educational

models [11, 18–23] and educators who support learners' intrinsically motivated competence [17, 24]. Relatedness, the component of SDT least examined in medical education literature, is defined as the feeling of belonging to a learning community and being valued by its members [7]. A review of the literature reveals various strategies for developing learner relatedness [5–7, 16, 17, 25–27]. But gaps exist for describing how it contributes to self-motivated learning [25].

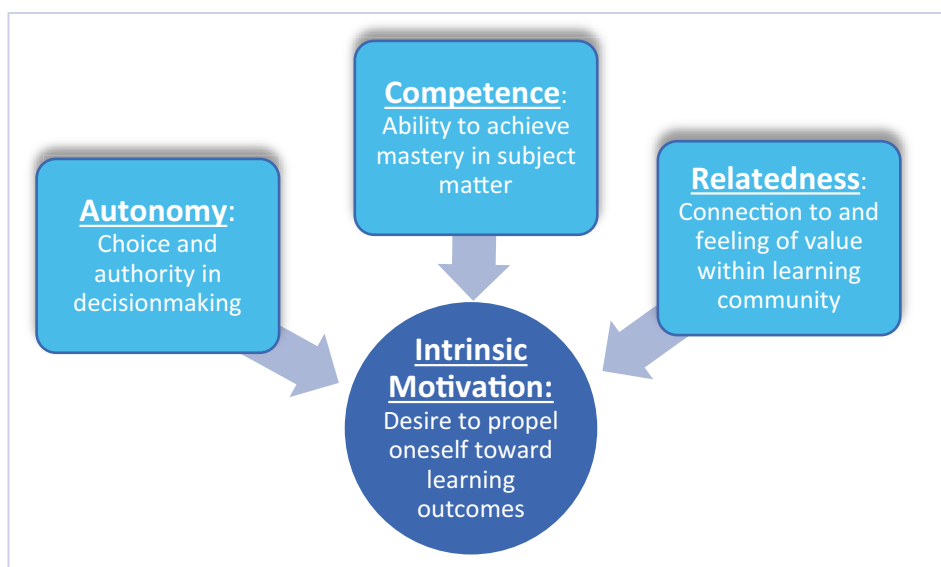
The literature on SDT in medical education is growing, yet only a handful of research studies examine all 3 constructs of motivation [15, 17] or capture how learners articulate their acquisition of skills [27, 28] within these constructs. Some research [17, 28] examines the related construct of self-directed learning, which emphasizes learner management of educational activities. Nothnagle et al. [28] find that some residents can define the concept of self-directed learning, but they lack confidence in self-management skills and rely upon external direction to set and achieve educational goals. Some residents express a preference for active learning modalities such as patient care, and in doing so, perceive the acquisition of clinical competence and self-directed learning skills as competing priorities [28]. Burford et al., however, note that increased learner agency (“engagement with and pursuit of educational opportunities” [29 p. 6]) may influence not only the perceived competence of an individual not only to oneself,



Adapted from Ryan, R. M., & Deci, E. L. (2000) *American Psychologist*; © 2017 Center for Self-Determination Theory

Fig. 1 Ryan & Deci's Self-determination theory. Adapted from Ryan, R. M., and Deci, E. L. (2000) *American psychologist*; © 2017 Center for Self-Determination Theory

Fig. 2 Self-determination theory constructs of motivation



but also to faculty. Similarly, Biondi et al. [17] observe that when faculty perceive learners to be “passive,” that is, not exhibiting traits of self-directed learning or motivation [30], opportunities for autonomous participation in patient care may be withheld.

While SDT in medical education [4, 5, 14, 27, 31, 32] has been studied at both the undergraduate [7, 25] and graduate levels [17, 18, 24, 30, 33, 34], few studies address the longitudinal outcomes of a curriculum informed by SDT. A 2011 systematic review of motivation in medical education [26] poses several questions that remain unanswered in the extant research: Does learner motivation change during the training period? If so, how? How might curricular elements or educational environments contribute? This retrospective, mixed-methods case study describes changes in family medicine resident motivation levels through the analysis of articulations and behaviors of residents as they progress through a longitudinal curriculum designed to develop resilient lifelong, activated learners.

Methods

Setting and Population

The family medicine residency program at the center of this study is situated in an urban community teaching hospital system in southeastern Pennsylvania. The 3-year program enrolls 6 residents per post-graduate year (PGY) training level. In academic year (AY) 2007–2008, the residency program entered the 5-year Preparing the Personal Physician for Practice (P4) national demonstration project [35–37], and restructured its curriculum to emphasize a learner-centered

paradigm that encourages residents to actively participate in educational planning, self-assessment, and delivery of knowledge to clinicians and learner peers. Core goals of the residency redesign project included self-directed learning, self-care, and self-reflection on the residents’ professional lives. Similarly, the learning environments were intentionally structured to incorporate adult learning principles and support the building and nurturing of relationships that would lead to greater life satisfaction and career joy. A key component of participation in the P4 project was the development of a competency-based assessment system [38, 39]—which predated the 2014 implementation of the ACGME Milestones [40, 41]—emphasizing relationship-centered care as a domain of clinical competency.

Study Design and Reflexivity

This retrospective, mixed-methods case study explores the developmental trajectory of motivation among graduate-level medical learners by analyzing how residents articulated their learning process at various training intervals as captured in focus groups, residency assessment documents, individual education plans, and faculty observations of residents demonstrating lifelong learning behaviors. The data sources thus included self-reports and scores from direct observation of behaviors at both a group level and through an individual learner’s story. Data interpretation was informed by Adult Learning Theory, or andragogy [42], with a focus on the learners’ progress toward intrinsic motivation, as described by SDT [3, 4, 7, 26, 43].

At the time the study was conducted, all study team members were educational researchers and medical educators within the residency program. The study team employed

several validation strategies, including triangulation of data sets (qualitative and quantitative, self-report and faculty observations), triangulation of investigator perspectives, colleague examination (similar to member checking but validating from the perspective of a program creator rather than a participant) [44], and longitudinal study design to ensure in-depth understanding of participant experience [45, 46].

In assembling the study team, thought was given to their various roles: JAD participated in the design and implementation of the residency curriculum in a leadership role; SSM participated in the implementation of the residency redesign as a physician faculty; ND and LCG came on as medical educators post-P4 project entry; SEH joined the residency post-P4 to support evaluation efforts. During primary data analysis for this project, JAD abstained from preliminary coding of themes in deference to her role in curriculum design, instead serving in a colleague examination role to validate the resulting themes and ensure that the team stayed focused on the purpose of the data inquiry.

Data Analysis

Prior to the initiation of data analysis, the health network's institutional review board attested that this study met the federal requirements for exemption per 45 CFR 46.101(b). The various data sources used in this study (Table 1, Box 1) were collected from a population of 51 residents enrolled in the residency between July 2009 and June 2015 (AY 2010 through AY 2015). All data sets were retrospective, and the focus group transcript data set was extracted from an existing NVivo software project utilized by the P4 evaluation team. The nodes used by the P4 evaluation team informed the operationalization of this study's coding framework (Box 2).

The study team separated these data sources into 3 subgroups for analysis: 2 qualitative data sets (Aggregated-Qual and Individual-Qual) and one quantitative data set (Aggregated-Quant). Using a “concurrent triangulation design,” [46, p. 217] the study team moved systematically through the data sets in this order: (1) Aggregated-Qual, (2) Individual-Qual, and (3) Aggregated-Quant. Results were compared after the analysis of each set was completed.

The team took a phenomenological approach to the qualitative data, seeking to describe the real-life experience [46] of residents in our program by examining how they articulated the process and purpose of acquiring knowledge and skills. Analysis took place in several stages, as described in Table 1 and Box 2. The methodology used includes aspects of evolved grounded theory [47], in that the study team has strong theoretical sensitivity as a result of their careers in medical education. In addition, data exploration was situated within the extant literature of andragogy [42] and SDT [3, 4,

6, 34], and the process did not engage all the precision tools laid out by grounded theory traditionalists. Other elements of grounded theory utilized included inductive [48] and iterative exploration of the data across PGY-level subsets.

Initial analysis of the blinded PGY-level focus group data subsets began with consensus coding to ensure agreement between coders. Then, sets of 2 study team members performed thematic analysis [49] of each data subset, each independently looking for emergent themes. The whole team gathered when the team members shared their findings, with JAD and the 2 remaining team members present as colleague examiners to support synthesis and resolve discordant coding results. Once consensus was reached for each subset, exemplar quotes were gleaned to support the development of the data subset narratives that captured the voice of the data set.

The quantitative data set was aggregated and stratified by PGY, and observable behaviors were classified based on the Dreyfus model of skill acquisition [50]. A radar graph representing the average score for each SDT component (derived from thousands of faculty observations of residents) emerged for each PGY-level data subset.

Operationalization of Motivation

The multistage analysis process (Fig. 3) culminated in the determination of motivation levels for residents at 4 points in their training: PGY1 post-orientation (serving as the baseline measurement) and the end of each training year (PGY1, PGY2, and PGY3). For the qualitative data sets, the study team used an iterative process of independent, comparison, and consensus coding to identify quotes exemplifying each of the constructs of SDT. The study team relied heavily on the Ryan and Deci definitions of each construct [3] to code focus group and resident assessment meeting transcripts. For example, *autonomy*, the perception that one controls one's own activities (or “internal perceived locus of causality” [3, p. 70]), manifests in articulations by our residents such as, “I think the flexibility, um, especially the selective time, has made it possible to ... really include different aspects that are important to a person” and “I think there's less organized activities for us to be learning something. It's all us developing it ... it can be a little exhausting, and it can also cut down some of your enthusiasm, actually.” For *competence*, perceptions of “self-efficacy for the activity” [3, p. 69], sounded like, “I don't feel comfortable with a lot of what I know, or confident in seeing someone and saying, ‘This is what's going on’” and “The stuff like adult learning ... I think it's being planted in my brain but it's not actually happening yet.” The concept of *relatedness*—defined as a sense of security, “belongingness [sic] and connectedness with others” [3, p. 73]—most commonly appeared as statements about feeling supported emotionally or academically

Table 1 Data sets and analysis

Data	N	Description	Analysis process
Aggregated-Qual			
Focus group transcripts	51	24 transcripts (12 PGY1, 6 PGY2, 6 PGY3): Audio recordings of cohort sessions collected July 2009 through June 2015. PGY1s participate in 2 focus groups (post-orientation and end of year); PGY2 and PGY3 focus groups occur at the end of each academic year	This data set was part of an existing data set collected by the residency since program inception. Residents in each PGY cohort participate in focus groups 4 times throughout their training: post-orientation and at the end of each academic year. Our study team extracted data from an existing NVivo software project file containing focus group transcripts coded to a priori adult learning nodes by the P4 evaluation team. Study team members operationalized the P4 project nodes into data sets relevant to SDT constructs (see Box 2). Data was stratified by PGY level and extracted for analysis. Two study team members independently coded the blinded PGY-level data sets for emergent themes, with remaining study team members serving in the colleague examination role. Using the results of consensus coding along with exemplar quotes, the team synthesized themes into narratives and assigned motivation levels based on the SDT continuum
Individual-Qual			
Resident assessment meeting transcripts	1	7 transcripts (3 PGY1, 2 PGY2, 2 PGY3): Audio recordings of an individual resident's assessment meetings. Resident enrolled at some point during the residency's p ⁴ pilot period (July 2008 through June 2012)	The population for the individual learner data set included only those residents who had completed all 3 years of residency training under the restructured curriculum. The data set analyzed for this case study was of a learner for whom the residency had the most complete set of educational documentation related to the resident assessment meetings (i.e., recorded meeting transcripts, individual plans and summary statements). The same analysis process was used as described above for the focus group transcripts. Our method of having 2 team members doing initial coding and adding JAD into the secondary analysis stage meant the remaining 2 team members served in the colleague examination role and were available to mediate discussion and resolution when differences in interpretation and coding arose
Individual education plans	1	6 notes (3 PGY1, 1 PGY2, 2 PGY3): Documents authored by the resident and advisor that serve as an agenda for the assessment meeting. Contain educational progress and plans. Resident, advisor, and program director sign the document, signifying it as a learning contract	
Resident assessment meeting summaries	1	6 summaries (2 PGY1, 2 PGY2, 2 PGY3): Short narratives created by the resident for residency community that serve as a summary of the resident assessment meeting and offers guidance on how to help the resident meet goals for next assessment period	
Aggregated Resident Learners-Quant			
Lifelong learning competency scores	18	6,356 scores (497 from first half of PGY1; 1,072 end of PGY1; 1,218 end of PGY2; 1,138 end of PGY3): Faculty observing residents in various educational environments (outpatient clinic, inpatient service, classroom) completed assessment forms the indicating whether the learner was "Observed" exhibiting specific behaviors related to the Lifelong Learning competency domain, part of the residency-designed competency assessment system [38]. This study includes scores collected July 2009 through June 2014.*	The study team mapped the observable behaviors scored by faculty to relevant SDT constructs (competence, autonomy, relatedness) [3]. After transforming these variables, the scores were aggregated and stratified by PGY level and SDT construct. Then, the percentage of times residents at each PGY level were "Observed" performing a behavior related to an SDT construct were calculated. Radar graphs generated using Excel illustrate these percentages. Each "petal" on the radar graph on Table 4 represents one SDT construct. The height of the petal indicates a higher frequency of "Observed" scores, while a wider petal indicates observed behaviors represent a range of developmental skill levels, as per the Dreyfus model of skill acquisition [50]

* ACGME Milestones system implemented in July 2014, replacing the residency's competency scoring system

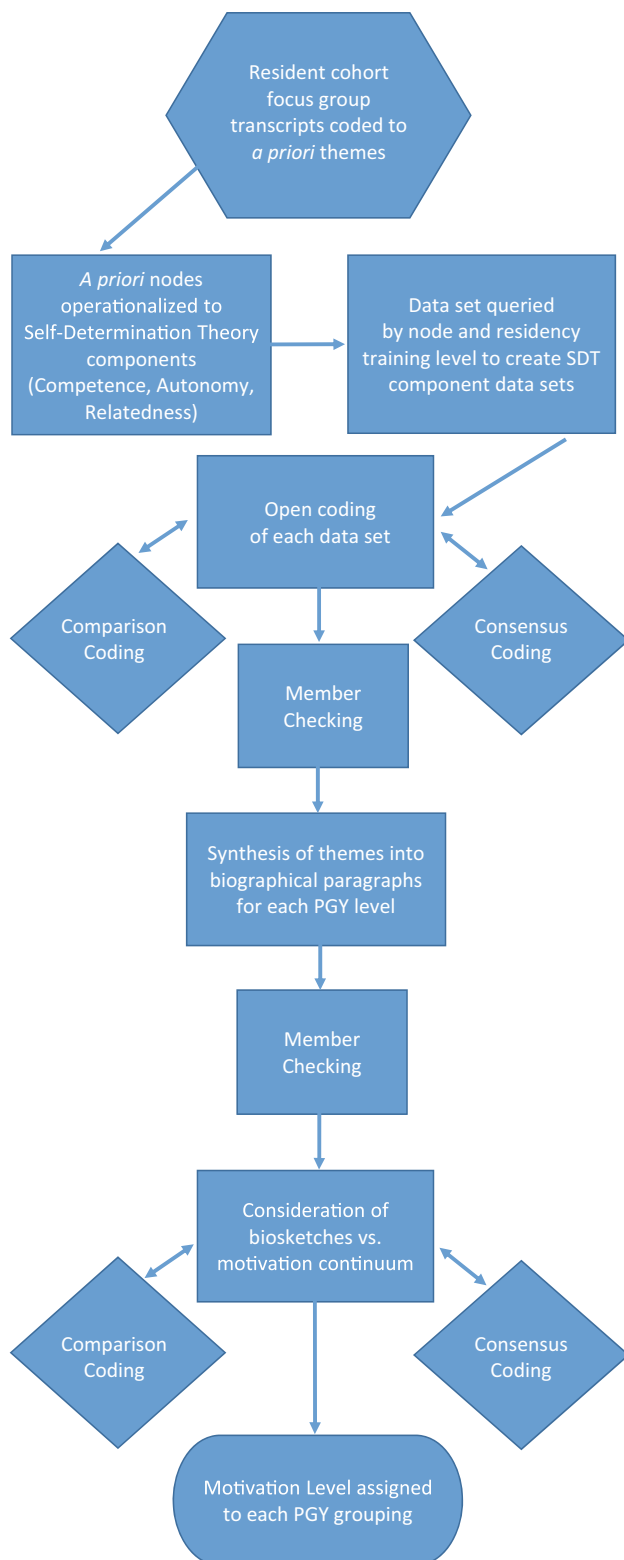


Fig. 3 Methods flowchart

by faculty and fellow residents: “Some of the attendings are, like, my friends, you know? And I didn’t expect that, I kind of just thought that they’re, like, my boss.”

The study team synthesized the emergent themes for each SDT construct into descriptive paragraphs for each PGY data subgroup. The resulting motivation levels for each PGY are based on resident statements addressing their educational autonomy, competence in adult learning behaviors, and their relationships within the educational environment. The paragraphs for each PGY training level are compared with the descriptions of motivation along the SDT continuum (Fig. 1). The relative contribution of each component’s narrative informed the motivation level assigned to each PGY training interval subgroup.

The quantitative data set includes resident competency scores culled from the residency’s program-specific Lifelong Learning domain. Previous reports detail how the residency generated an assessment system [38] based on developmentally appropriate observable behaviors using a radar graph to illustrate competency [39] within multiple graduate-level family medicine domains. For this study, the team aggregated scores from the Lifelong Learning domain of the 18 residents who graduated between June 2012 and June 2014. (The residency implemented its competency assessment system in July 2009, and the ACGME’s Family Medicine Milestone Project [40, 41] began in July 2014, replacing the program’s competency scoring system. Therefore, only 3 resident cohorts with data from all 3 years of residency training were available for analysis.) The study team aligned the Lifelong Learning observable behavior standards from our competency assessment system [38, 39] with the SDT constructs. Then, radar graphs were generated—using the transformed variables—to show the average frequency with which residents at each PGY level exhibited behaviors related to autonomy, relatedness, and competence.

Recognizing that the motivation categories occur along a continuum without defined boundaries, the study team left the quantitative data set in its deconstructed form, with each “petal” of the radar graphs representing one of the three SDT constructs. The petals “grow” as behaviors aligned with each construct increase in frequency (height of petal) and complexity (width of petal), as tracked along the Dreyfus competency scale [50]. The change illustrated offers a point of triangulation with the results from the two qualitative data sets.

Results

The Aggregated-Qual and Individual-Qual analysis phases result in a matrix illustrating the narratives generated for the 12 Aggregated-Qual (Table 2) and 12 Individual-Qual (Table 3) points in time—one paragraph for each SDT

Table 2 Aggregated-Qual subset results. Narratives for each SDT construct and resulting motivation level by training level

PGY level	Competence	Autonomy	Relatedness	Motivation level
PGY1 Beginning of year	Feeling overwhelmed and uncertain in their new roles, residents seek <i>external assessment</i> of their clinical competency. They <i>focus on the challenges</i> of an unfamiliar educational process as they discuss their fears about preparing for the boards and making decisions independently about patient care. Seeing the upper-year residents at work stokes their anxiety as they <i>recognize that soon they will be expected to perform</i> at that level	The opportunity to find their own path attracted these learners to the residency, but they soon realize that they will need help navigating the expectations and realities of their new environment. They are eager to be able to make decisions independently, both in the clinic and about their educational plans, and have high expectations for themselves. In describing their approach to learning, they express both appreciation for and frustration with the resources they can access	The residents say they <i>feel welcomed into family medicine right away</i> , citing how faculty and staff engage them on a personal level and offered unsolicited support. They recognize that orientation activities are designed to build trust between cohort members, and they <i>appreciate being encouraged to form a variety of mentoring relationships</i> within the department. Residents <i>begin to articulate how these relationships and feelings of safety contribute to the process of becoming adult learners</i>	Introjection
PGY1 End of year	Recognizing that learning is a process, <i>residents reflect on how comfortable they feel</i> and they <i>articulate what they know to inform their self-assessment process</i> . Though they see the value of setting educational goals, they <i>express skepticism about whether they are progressing</i> at an appropriate pace toward clinical competency and as adult learners. They name time management and care of chronically ill patients as areas in which they have experienced some growing pains	Testing the bounds of the program's expectations and privileges, the residents become more assertive about their learning preferences and concerns. While they accept some responsibility for filling their learning gaps, they more frequently point to external barriers. The residents bristle at what they perceive to be low-yield residency requirements that consume precious time. They continue to seek opportunities to exercise independence in clinical decision-making, although their focus remains on gaining medical knowledge	The residents describe interactions they have had throughout the year in their various roles as learners. They indicate having strong connections with peers, advisors, and family medicine faculty and <i>can express disagreements without jeopardizing these relationships</i> . They <i>express concerns about how some community preceptors and residents in other specialties might perceive them</i> , as well as <i>anxiety about whether they can meet expectations</i> of family medicine faculty as well as incoming PGY1s. Overall, they continue to feel supported in the clinical setting and educational process. They also <i>recognize how their engagement has expanded</i> over time and how relationships are shifting as a result	Introjection
PGY2 End of year	Residents <i>can identify the various roles they perform</i> and <i>see their growth</i> in these realms. Yet they <i>continue to question whether they will acquire all the knowledge and skills they feel they need to feel confident</i> about their competence in their craft. <i>Reflections about the learning process</i> include references to what is and isn't working, what they know and need to know, and what learning will look like beyond residency training	Residents offer specific examples of how they have taken initiatives to gain new knowledge and clinical experiences. While they <i>appreciate the ability to be flexible with their learning</i> , many residents express a desire for more traditional learning methodologies (e.g., lectures and blocks of clinical experiences) as they <i>note concerns about progression toward clinical competency</i> . Residents <i>embrace opportunities to collaborate</i> with faculty and other health care team members and <i>recognize their role in ensuring learning is lifelong</i>	Citing strong connections with faculty and co-learners, residents at this level <i>trust the authenticity of the support they are offered</i> . As a result, they shed their protective barriers in the name of better patient care and learning opportunities. The residents <i>observe the effect of various relationships</i> on the work and learning environment as well as their own individual impact on others and the system. Some <i>concerns about how they are perceived</i> remain. While residents discuss challenging interactions, they <i>identify communication strategies</i> that facilitate transparency of meaning and promote problem solving	Identification

Table 2 (continued)

PGY level	Competence	Autonomy	Relatedness	Motivation level
PGY3 End of year	Residents <i>reflect</i> on how the skills they honed as adult learners contribute to their goals for clinical competency. They <i>cite specific tools</i> , such as self-care practices and relationship-centered care models, which they found useful. They <i>recognize the challenges faced</i> while transitioning from novice physicians to activated lifelong learners. <i>Success stories emerge</i> in the form of patient relationships, practice improvement projects, and ideas for enriching curricular content	<i>Claiming ownership of and appreciation for their educational choices</i> , these learners <i>reflect on the paths taken and not taken</i> during residency. They <i>can cite action steps they initiated</i> to fulfill their learning needs and <i>explain why</i> some learning methods did not work for them. These <i>residents recognize their progression</i> as individual learners who <i>have the ability to harness resources to advance their own goals</i>	<i>Reflecting on their identity</i> as a cohort and as members of the family medicine profession, residents <i>express a sense of cohesion, trust and teamwork</i> – both in patient care and the educational process—with patients, junior residents, faculty and other colleagues across the health network. Some concerns are raised about lack of transparency when individual learners struggle, related to how that might impact the cohort's function. They also <i>struggle to trust whether different learning experiences within the individualized curriculum</i> produces equally competent colleagues. The residents <i>value the support</i> given along their educational journey and state the intention to “pour it out into others.”	Identification/ integration

construct in each of the 4 training-level subsets. The study team's determination of motivation level for each PGY cohort appears in the rightmost column of each table.

The Aggregated-Quant analysis resulted in a series of radar graph charts. Table 4 offers an at-a-glance comparison of the radar graphs alongside the qualitative data set motivation levels assigned by the study team based on the model (Fig. 1) derived from the foundational work of Ryan and Deci [3]. Below, the authors describe the rationale for each motivation-level assignment at each PGY level.

Aggregated-Qual Subsets

Early PGY1 resident comments indicated that this group appreciated the opportunities to make their own decisions, but they needed a substantial amount of external validation and clarification of purpose to navigate learning objectives, resulting in an assigned motivation level of *Introjection*.

By the end of the first year of training, the residents exhibited nuances of valuing their learning activities. They often reflected concerns about others' perceptions of their competence and their perceived external barriers to progress. Therefore, the study team deemed that these learners had not quite moved beyond the *Introjection* stage of motivation.

In PGY2 and PGY3, the residents increasingly demonstrated internalization of their own learning goals. By the end of the second year, the residents articulated areas of progress and their preferred learning styles, while noting the impact of various relationships on their growth in professional identity as physicians. At this stage, residents continued to question their competence in becoming the independent practitioners they desired to be. The study team classified both PGY2 and PGY3 learners in the *Identification* stage. However, it was noted that the PGY3 learners were at the cusp of *Integration*, based on their assumptions of ownership of educational decision-making, ability to reflect on their individual and group identities, and how each informed these choices. The tendency to elevate external rewards and purposes and incongruent valuation of individual learning pathways informed the decision not to advance this group's motivation classification.

Individual-Qual Subsets

In early PGY1, the learner exhibited motivation at the *Identification* level by assuming ownership of educational needs and independently setting goals for chosen learning experiences. Although feeling welcomed to the learning community, the resident expressed concern about an inability to be fully self-reliant in the new environment. This worry suggested ego involvement, which kept the study team from advancing to *Integration* at this stage of learning.

Table 3 Individual-Qual subset results. Biographical sketch of SDT construct and resulting motivation level for individual learners at specified training intervals

PGY level	Competence	Autonomy	Relatedness	Motivation level
PGY1 Beginning of year	The resident voices areas of need and articulates ownership in a process to improve knowledge	Resident embraces opportunity to select learning experiences and discusses process for choices made. Resident initiates and develops visit to patient education center to fill perceived gaps in medical knowledge	Resident feels welcomed into the community by others and sees opportunities for forging relationships. While "feeling some anxiety about working with specific attendings," resident recognizes ability to learn from them despite this discomfort. Stressors include relying too much on others	Identification/integration
PGY1 End of year	Competency is perceived through multiple external sources, such as the guidance of an advisor and in comparing self to others. Resident begins to include some internal perspectives on own competency by listing characteristics of learning process and at times expressing surprise at the types of learning experiences that felt successful	Resident begins to take initiative at continuity care site and articulates value of learning through doing. Expresses frustration when scheduling hiccups, inability to access resources and workplace culture impedes progression toward independence. Continues to follow own organized system to stay on track with gaining exposure to a variety of clinical topics	Develops relationships with upper-year residents after gaining a better understanding about how they were formed and the obstacles in developing them. Recognizes the role of relationships in advancing knowledge. Feels more comfortable in being the only resident in the continuity care site	Introjection/identification
PGY2 End of year	Resident recognizes progress on learning path and articulates a feeling of growing confidence as a family doctor. When using data to assess competency, resident begins to identify the reasons for assigning specific self-assessment scores and compare that with feedback from external sources. Resident can identify areas of struggle in learning process	Recognizing a gap in training for interns, resident initiates creation of ICU orientation guide. Not limited by resident status or the curricular framework, the learner continues to experiment with gaining knowledge through a variety of experiences. In considering a chief resident position, resident recognizes role as member of various teams (ED, continuity care site) and possible challenges, while embracing opportunity to gain leadership skills	Resident becomes aware of contributions to relationships and reflects on changing roles within practice site and residency. More examples of collaboration arise – creation of training guide, discussions about practice improvement project, establishment of patient panel – although limited feedback creates discrepancy between resident's and evaluators' assessments of growth. Recognizes how relational skills impact leadership style, which influence perception of self and others	Identification
PGY3 End of year	Resident perceives self as a competent doctor, identifies learning as a process that is dynamic and expects to experience continued growth and fears. Self-assessment of competence is determined by comparing own performance to example statements from assessment forms, obtaining feedback from trusted sources, and identifying when professional activities and thought processes feel like "second nature." Resident shares concerns about future colleagues judging patient care decisions and recognizes value of articulating thought processes as means of communicating competency to others. Approaches future learning with "cautious optimism" and an openness to continue learning	Preferred learning style articulated as seeking to be actively engaged, whether through chosen or required experiences. Resident reflected that selective choices were sometimes determined by program requirements and sometimes by own interests and desires. Learner acknowledged missed opportunities to stand up to some preceptors, rather than just agreeing to their plans. Also, this resident identified struggles with job applications, as there is no standard process like those in place for previous transitions from college to medical school to residency. In imagining post-residency learning trajectory, this resident indicates a desire to maintain competency in a variety of subject areas	Resident identifies skills necessary to develop and maintain relationships, citing group activities and setting aside time for community building. In particular, the learner articulated the value of having a safe environment for reporting sensitive issues like duty-hour violations and for communicating standards and expectations for new community members (PGY1 residents). This resident voices anticipatory anxiety about how to earn the trust of future colleagues in making clinical care decisions	Identification

Table 4 Mixed method result comparison. Motivation levels and radar graph illustrations for each data set at each time interval

Data Set	Early PGY1	PGY1 End of year	PGY2 End of year	PGY3 End of year
Aggregated Resident Learners	Introjection (Controlled)	Introjection (Controlled)	Identification (Autonomous)	Identification/Integration (Autonomous)
Individual Learner	Identification/Integration (Autonomous)	Introjection/Identification (Controlled/Autonomous)	Identification (Autonomous)	Identification (Autonomous)
Aggregated Resident Learners-Quant (Observable behavior skill difficulty increases in clockwise direction)	 Autonomy: Novice at cusp of Advanced Beginner Competence: Novice at cusp of Advanced Beginner Relatedness: Novice at cusp of Advanced Beginner	 Autonomy: Novice at cusp of Advanced Beginner Competence: Novice at cusp of Advanced Beginner Relatedness: Novice at cusp of Advanced Beginner	 Autonomy: Advanced Beginner at cusp of Competent Competence: Competent Relatedness: Advanced Beginner at cusp of Competent	 Autonomy: Competent at cusp of Proficient Competence: Competent Relatedness: Competent as cusp of Proficient

As the learner gained perspective about roles and educational experiences available at the end of the PGY1 year, doubts crept in about competency and frustrations emerged with perceived barriers to autonomy. The resident began to describe self through the lens of external sources; appreciating expanded opportunities to develop learning relationships but losing some intrinsic behaviors in the process. Thus, motivation at this stage is classified as *Introjection*, approaching *Identification*.

By the end of PGY2, this resident reached a stride in articulating competence as a family physician, triangulating feedback from multiple sources to self-assess progress. The resident found areas of innovation in developing learning experiences for self and others. The resident recognized that stepping into leadership roles changed relationships with others, leaving oneself vulnerable to compromised perceptions of self. These observations informed a motivation classification of *Identification*.

The resident remained at the *Identification* level at the culmination of the PGY3 training year. With a clear ability to articulate the preferred learning style and a desire to discern learning activities chosen independently from those required by the training program, the resident noted

the value of relationships for not only pursuing future professional endeavors but also in creating a supportive community for personal growth. Advancement to *Integration* is impeded only by the resident's worries around future colleagues' perceptions of the learner's clinical competence.

Aggregated-Quant Subsets

The radar graphs in Table 4 include a total of 6356 scores from faculty observations of 18 unique residents. The graphs represent the average frequency with which residents in each PGY level exhibited behaviors relating to the 3SDT constructs. Each "petal" represents one construct, with behaviors increasing in skill level moving clockwise around the graph. Wider petals indicate higher-skill behaviors observed based on Dreyfus et al.'s model of skill acquisition (Novice, Advanced Beginner, Competent, Proficient) [50]. The height of the petals indicates frequency of observation of behaviors, while the width of each petal expands as residents exhibit more complicated behaviors. Table 4 illustrates an increase in frequency of higher-level behaviors as residents progressed through residency training.

Discussion

Stratifying by PGY level for both the aggregated and individual learner data sets allowed the study team to track progress along the SDT continuum across the residency training period. Looking at the arc of the residency training trajectory, similar patterns emerged in the Aggregated-Qual and Aggregated-Quant data sets. Aggregated-Qual showed learner progression along the SDT continuum (Fig. 1) within the controlled motivation segment from beginning to end of PGY1. By the end of PGY2, data shows learners moving into the early stages of autonomous motivation (*Identification*). At the end of the third year of training, residents occasionally spoke using terms that indicated they had reached *Integration*, a fully internal form of motivation. The Aggregated-Quant data set showed a congruent arc in frequency of advanced-level behaviors in each of the construct realms, as evidenced by the chronological burgeoning of “petals” on the radar graphs from beginning of PGY1 to the end of PGY3.

The individual resident’s trajectory tells a different story. In the Individual-Qual data set, the level of motivation in early PGY1 (*Identification*) was in the autonomous motivation range. Then it shifted to a controlled motivation level (*Introduction*) by the end of PGY1 and moved back to the autonomous motivation realm (*Identification*) in PGY2 and PGY3. In fact, the resident did not return to the higher motivational level (*Integration*) that was observed at the start of PGY1. This resident’s motivation level appeared to be affected by the external competence requirements that distinguish medical education (e.g., passing the licensing exam) and the relatedness challenges that accompany career transitions (e.g., establishing oneself in professional practice and developing trusting relationships with new colleagues and patients).

The study design included the individual learner’s story as an “N of 1” [44] to illustrate how paying attention to the way a learner articulates his or her educational journey can offer clues to where they might need guidance toward opportunities for engaging with others (relatedness), perceiving competence as learners, or taking ownership of their learning goals and pathway (autonomy). The intention was not for this learner’s story to suggest generalizable outcomes, but rather to offer further evidence of how using SDT as a framework can illuminate a resident’s movement along the motivation continuum. Providing this perspective in a way that is visible to both learner and teacher encourages self-reflection and enhances self-awareness for the learner and offers contextual clarity for the educator.

Each data set demonstrated changes in motivation across residency training toward more autonomous, or internal, motivation. Residents referred to a variety of the curricular and learning environment innovations instituted by this program that mirror the “12 tips” identified by Kusrkar

et al. [27] as necessary for an educational environment to nurture intrinsic motivation. These innovations included the opportunity for choice in learning experiences (facilitated by the residency’s longitudinal curriculum; a transparent, individualized resident assessment process [51, 52] that includes self-assessment and is supported by triangulation [53]; community activities to build trust and a web of supportive relationships where disagreement can be expressed and heard (residency-wide retreats) [54, 55]; active engagement with faculty to learn and teach others; skill building in resilience, communication, relationship-centered care, and adult learning [52, 53]; time for guided reflection (resident cohort retreats and dedicated curricular time for Balint [56] and other reflective activities) [54, 55]; and opportunities to lead and participate in teams, e.g., resident-run practice improvement projects and family medicine practice sites with inter-professional, collaborative care models).

Residents at various training levels also noted aspects of the program they saw as barriers to the development of autonomous motivation. These included the complexity of the learning system: mismatches in preferred learning styles and residency didactic strategies (expectation for self-directed learning rather than lecture-based didactics); the structure of some clinical learning opportunities; conflicting demands on time; complexity of patient care; and challenges to family medicine identity [57] via expectations and behaviors of attending physicians and learners from other specialties. While noted as a challenge early in their training, the attention placed on developing adult learning skills ultimately resonated with many residents. They expressed appreciation for the transparency of the metacognitive process and support for activities encouraging them to reflect on their own progress in becoming adult learners. This shift led the research team to notice, like Orsini et al. [6], that motivation levels fluctuate, particularly at times of transition. Residents taught to be aware of their roles and skills in self-directed learning [58] may be better positioned for the challenges that arise throughout their careers. Examples include preparation for board exams, flexibility during practice transformation, or navigating challenges through clinical uncertainty [1].

Limitations

This is a case study of one family medicine residency training program. While the results are not generalizable to other graduate medical training programs, the authors believe the findings offer insight into what acquisition of learner motivation looks and sounds like in medical learners and how it might shift throughout the training process. Another potential limitation is that the study team included some individuals who participated in the design, implementation, and

delivery of the residency's P4 pilot innovations, while others upheld the goals of the demonstration project as faculty members. Although the study team members approached data analysis with an awareness of their roles and congruent biases and implemented processes to minimize these effects, the authors acknowledge the inherent bias of their perspectives.

As noted previously, this study examined focus groups, documents, and faculty observation tools that were not designed to measure SDT. At the time of the residency program's redesign in 2007 [38], SDT in medical education was an emerging idea. Data analysis for this project began in 2015, and SDT was determined to be most congruent with the residency's curricular changes and approach to lifelong learning, based on the relevant publications [4, 5, 8, 25, 27] at the time. Since motivation occurs along a continuum, the study team choose to assign a single level that best represents the data sets based on thematic analysis and triangulation with data sets across time. While the observable behaviors illustrated by the radar graphs [38, 39] align with one or more components of SDT, they were developed according to theories of adult learning [44]. Also, use of observable behaviors as proxies for motivation is limited by an observer's inability to know the true reasoning behind a behavior, unless elicited through precepting conversations or learner reflections. Future evaluation studies might opt prospectively to use instruments designed to measure SDT and motivation, such as the Academic Motivation Scale (AMS), Reflection-in-Learning Scale (RLS), and a short version of the Approaches to Study Inventory (s-ASI), instead of, or in addition to, a radar graph model [59]. These self-report tools also might be used in lieu of the qualitative data sets.

Future Research and Use in Medical Education

Examining self-motivation in medical learners affords a deeper understanding of clinical teaching and learning processes and has many implications for curriculum development, assessment, teaching, and self-directed learning [4]. Suggestions for addressing learner autonomy in medical education include teaching and learning environments that encourage intrinsic motivation [7, 14, 25, 27] and scaffolding to support learner development [24, 27]. Various authors argue that a change to the learning environment and a learner-centered approach influence student motivation [6, 60, 61] and can result in internal guidance and self-directed learning [12]. Some researchers [4] suggest that an examination of SDT might offer clues regarding needed changes in teaching methods and curricular design and recommend that future research identify ways to stimulate autonomous forms of motivation and intrinsic regulation in learners. Further studies might include learners from multiple specialties to describe the levels of motivation present in graduate medical

education or develop tools to assess the degree to which training programs support a learner-centered approach and other SDT-supportive environmental factors. The latter could be a valuable tool for individual program evaluation and accreditation reporting.

Harnessing motivation also might serve as a means of resilience training for clinicians. A systematic review of motivation across health professions education [6] revealed affective outcomes including burnout, negative emotions, and stress levels. Well-being correlated with autonomous motivation, while controlled motivation levels and lack of autonomy support are often an indicator of burnout [4]. Using SDT measurement tools for learner self-assessment, combined with reflection and dialog in a supportive community, may encourage the development of individual aptitude in the autonomy, competence, and relatedness realms leading to improved individual learning and well-being.

Conclusion

Family medicine residents trained in a program whose curriculum and culture were intentionally designed to foster adult learning principles showed growth in motivation levels from controlled to autonomous. Incorporating program evaluation plans and learner assessment tools that measure not only learner competence but also relatedness and autonomy may help move graduate medical education toward a system that supports and encourages the development of clinicians well-equipped for learning. The next generation of residents could be better prepared to thrive intellectually and emotionally throughout their clinical careers.

Box 1: Focus group questions used for this study

PGY1 post-orientation

1. Where are you getting support? (e.g., Who do you talk to when things get rough, etc.)
2. What is your understanding of adult learning or how would you define it?
3. If you had to give two adjectives of where you were during orientation and where you are now, what would they be?
4. How was the orientation month?
5. How might you change your first two months?
6. How can the program support you the rest of the intern year?
7. What are your hopes, fears, and expectations—personal and professional—for the rest of your internship the year?

PGY1 end of year

1. What has your general experience of the last year been?
2. How comfortable do you feel with sickness and sick patients?
3. What has been helpful in the program, the things that have assisted you in getting through the year?
4. What has been unhelpful for you, those things that have made your path an uphill battle?
5. Can you describe the expectations for you from the program? (If unsure/unknown: Do you know the expectations for you as an adult learner?)
6. What is your understanding of adult learning?
7. How well did the program do with adult learning or how well did the program facilitate this?
8. How much of a role have you had in shaping your learning experience? Was this more or less than what you expected?
9. How connected or disconnected do you feel with the program, the Department of Family Medicine, the residency practice site, the faculty, and staff?
10. What would you change for the internship year? (e.g., didactic sessions, nursing home experience, hospital rotation, inter-professional care team)
11. What are you afraid of this upcoming year?
12. How have your interactions been with ...

- Residents in this cohort
- Upper years in this program
- Residents in other programs
- Hospital physicians and staff
- Family Practice Faculty
- Practice site team leaders, nurses, and staff

13. What are your hopes for this upcoming year, on a personal and professional level?

PGY2 end of year

1. Can you give an example of a challenging doctor-patient relationship, and how you have handled it? What resources did you use?
2. What has been helpful in the program? (the things that have assisted you in getting through the year)
3. What has been unhelpful for you? (those things that have made your path an uphill battle)
4. What is your understanding of Adult Learning or how would you define it?
5. How well did the program do with adult learning or how well did the program facilitate this?
6. How have your interactions been with the...

- Other family practice residents
- Family Health Center team leaders, nurses, and staff
- Family Practice Faculty
- Residents from other programs
- Hospital physicians and staff

16. What are your hopes for this year, on a personal and professional level?

PGY3 end of year

1. How has the program prepared you for your career? (Probes: In what ways do you feel most prepared? Least prepared?)
2. What is your understanding of adult learning or how would you define it?
3. How well did the program do with adult learning or how well did the program facilitate this?
4. How did you feel about teaching other residents? How prepared did you feel? Was there anything the program could have done to prepare you more?
5. How has it been for you to be here? (e.g., Family Medicine department, resident practice site, residency program, health network, community?)

Box 2: Operationalization of SDT nodes for analysis of qualitative data sets

Initial coding of qualitative data sets began with study team members analyzing transcripts deidentified by PGY level to reduce study team members' likelihood of associating developmental level with progression along the SDT motivation continuum.

A set of a priori nodes was constructed from an existing coding framework from the P4 evaluation team's analysis of adult learning behaviors. Here is the crosswalk the team created to operationalize Adult Learning nodes into SDT nodes:

- *SDTAuto* (Self-Determination Theory—Autonomy) = passages coded at *Locus of Control-Internal* grand-child node and/or *Shared Leadership* child node
- *SDTComp* (Self-Determination Theory—Competence) = passages coded at *Mastery & Growth* or *Relevance of Content* child nodes
- *SDTRelate* (Self-Determination Theory—Relatedness) = passages coded at *Relationships* child node

Four nodes within the Adult Learning schema did not align well with the SDT node operationalization. However, because the P4 evaluation team had deemed these data sets to contain

evidence of Adult Learning, we wanted to examine them for clues about learner activation and motivation that may have been more subtle. The operationalization of those nodes are:

- *ALBehav* = *Adult Learning Behaviors* child node (includes both *Exhibiting* and *Not Exhibiting* grandchild nodes)
- *Attitude* = *Attitudes learners have* about the educational process (includes both *Positive* and *Negative* grandchild nodes)
- *ALDef* = *Definition of Adult Learning* child node in which residents provide descriptions of what it means to be an adult learner
- *SysComplex* = *System Complexity* child node for when residents discussed how the way things are done within the residency affects their learning

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Declarations

Ethics Approval The Lehigh Valley Health Network's Institutional Review Board certified that this study met the federal requirements for exemption as per 45 CFR 46.101(b).

Conflict of Interest The authors declare no competing interests.

Other Disclosures A work-in-progress poster titled "Tracking the trajectory of residency competency in self-directed learning through the lens of self-determination theory" was presented at the Society of Teachers in Family Medicine Annual Spring Conference in Washington, D.C., on May 8, 2018.

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