Do Beliefs about Knowledge Predict Occupational Therapy Students' Critical Thinking? A Longitudinal Correlational Study

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Abstract

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Keywords

Cognition, knowledge, critical thinking, professional education, occupational therapy

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ABSTRACT

Beliefs about knowledge and knowing, or epistemic and ontological cognition (EOC), are potential influences on critical thinking, yet little research exploring these relationships has been published in educational literature or in occupational therapy (OT). This study examined the association between domain-general and OT-specific EOC and critical thinking in OT students. The Epistemological Beliefs Inventory, modified Four-Quadrant Scale, and Watson-Glaser Critical Thinking Appraisal were administered to a convenience sample of 102 OT students, before and after the didactic portion of an OT program. Results of logistic regression indicated that only the general belief in an omniscient authority as a source of knowledge was a statistically significant predictor of critical thinking, both before and after the didactic portion of the program. These findings partially support the hypothesis that EOC and critical thinking are related. Domain-general EOC and OT-specific ontological cognition also became more sophisticated over time, but OT-specific epistemic cognition and critical thinking did not change significantly.

INTRODUCTION

Critical thinking is foundational to the ability to reason in professional situations (Mattingly & Fleming, 1994; Unsworth & Baker, 2016; Vogel, Geelhoed, Grice, & Murphy, 2009), and the practice of occupational therapy (OT) places considerable demands on practitioners' critical thinking skills. Not only is critical thinking central to

practice in OT, it is espoused as a core outcome in higher education. It stands to reason, then, that OT educators are expected to facilitate critical thinking, and yet there has been little published research describing changes in critical thinking over the course of OT programs. Vogel and colleagues (2009) published the only longitudinal study of changes in critical thinking during an OT program, finding statistically significant increases in critical thinking scores before and after 20 months of didactic coursework in OT. By contrast, in a cross-sectional study, Lederer (2007) found no differences in the critical thinking disposition of students at different points in an OT program. Other studies have investigated the effects of specific educational approaches or time-limited interventions on critical thinking, and results have been mixed (e.g., Benson, Provident, & Szucs, 2013; Coker, 2010; Velde, Wittman, & Voss, 2006).

Research that not only describes changes in critical thinking, but also explores constructs related to critical thinking could help OT educators promote students' reasoning and facilitate preparation of competent practitioners. Surprisingly, Unsworth and Baker (2016) conducted a systematic review and found little in-depth exploration of constructs related to critical thinking in OT. One such construct may be beliefs about knowledge and knowing, or epistemic and ontological cognition (EOC), as educational psychologists have posited that sophisticated beliefs about knowledge and knowing may be prerequisites to skilled critical thinking (e.g., Hofer, 2004; Schommer-Aikins & Easter, 2006). This study sought to add to the literature by exploring the relationship between EOC and critical thinking and describing changes in EOC and critical thinking in OT students during the didactic portion of an OT program. Promoting a better understanding of the potential influences on critical thinking may assist educators as they strive to facilitate OT students' critical thinking.

LITERATURE REVIEW

Epistemic and Ontological Cognition
Over the past several decades educational psychologists and others have explored student beliefs about knowledge and knowing and their influence on learning (e.g., Brabeck, 1983; Bromme, Pieschl, & Stahl, 2010; Hofer, 2004). Studies of students from a range of disciplines; for example, psychology sociology, physics, and math (e.g., Buehl & Alexander, 2005; Hofer, 2000; Ismail, Hassan, Muhamad, Wan Ali, & Konting, 2013), have described various dimensions of beliefs and stages of development of these beliefs. Dimensions identified include beliefs in simple and certain knowledge, or ontological cognition, and beliefs in various sources and means of justification of knowledge, or epistemic cognition. Developmental trajectories from naïve to more sophisticated beliefs have been documented, with the developmental stages referred to by a number of different terms, depending on the author (Mitchell, 2013a).

Greene, Azevedo, and Torney-Purta (2008) used the term *ontological cognition* to denote beliefs about the nature of knowledge and its degree of certainty and simplicity. Some individuals believe that knowledge is certain, unchanging, and involves discrete facts, while others believe that knowledge is changeable and linked to other knowledge (Greene et al., 2008). Practitioners with a certain and simple view of knowledge might

seek standard protocols and expect "cookbook" answers to clinical problems. Once the one "right" answer has been identified, the need to engage in critical thinking to determine the best solution in the particular context is curtailed. On the other hand, practitioners with a tentative and integrated view of knowledge are more likely to consider multiple variables and formulate the best solution to a practice problem based on the context.

Epistemic cognition comprises beliefs about the source and justification of knowledge (Greene et al., 2008). Some practitioners may rely on experts for answers to clinical problems, while others may base decisions on prior experience. Still others may seek multiple sources of knowledge, including expert recommendations, research evidence, prior experience, and client needs and desires. Therapists who look to an expert authority for the "right" answer may see little need to think critically about a problem or situation, as opposed to practitioners who consider multiple sources of information to approach problems in a manner that is customized to individual clients and their contexts, needs, and values.

Greene, Torney-Purta, and Azevedo (2010) hypothesized that in domains such as OT, where there are multiple potential answers to a problem, ontological cognition develops before epistemic cognition. Individuals first begin believing in the complexity and tentative nature of knowledge before they move away from strong beliefs in an omniscient authority as the source of knowledge. Consistent with this theory, Mitchell's (2015) longitudinal study of EOC in OT students found that ontological cognition was more sophisticated than epistemic cognition at all points in time during the didactic portion of an OT program. Further, over the course of the didactic portion of the OT program, there were changes in epistemic cognition, but no changes in ontological cognition, perhaps because ontological cognition had already matured.

Research suggests that EOC may be both domain-general and domain-specific (Hofer, 2006). Domain-general beliefs develop outside of academic contexts and are applied similarly across any domain of knowledge, whereas domain-specific EOC may vary and be dependent on the academic context (Muis, Bendixen, & Haerle, 2006). Some authors theorize that domain-specific EOC develops from domain-general EOC (Beuhl & Alexander, 2006; Hofer, 2006) and that as individuals receive more specialized education in a domain, their EOC falls more in line with the discipline's EOC (Muis et al., 2006). Despite evidence of domain specificity and the importance of beliefs about knowledge and knowing to academic achievement (Ryan, 1984), self-regulated learning (Muis, 2007), metacognition (Schommer, Crouse, & Rhodes, 1992), motivation for learning (Bråten & Strømsø, 2004), the use of deep versus shallow learning strategies (DeBacker & Crowson, 2006), the ability to solve complex problems (Schraw, Dunkle, & Bendixen, 1995), recognition of ambiguity (Kardash & Scholes, 1996), and response to accurate refutation of misconceptions (Qian & Alverman, 1995), little research has been published regarding beliefs about knowledge and knowing in OT students.

Occupational therapists face complex problems with more than one potential solution. Solving these types of problems requires strong critical thinking skills and sophisticated beliefs about knowledge and knowing such as a recognition of the complex, tentative, contextual nature of knowledge. Knowledge must be applied based on the context of the individual receiving care, and solutions require consideration of multiple sources of knowledge, including research evidence, the needs and values of the individual, and the experience and judgment of the professional. Students with naïve beliefs about knowledge and knowing may struggle with the critical thinking and professional reasoning needed to provide effective care. Despite the fact that sophisticated beliefs about knowledge and knowing have been described as prerequisites to skilled critical thinking (e.g., Hofer, 2004; Schommer-Aikins & Easter, 2006), there is a lack of research that has investigated the relationship between critical thinking and EOC in general, much less with OT students. The purpose of this study, therefore, was to address gaps in the literature by exploring the development of and relationships between critical thinking and EOC in OT students.

Potential Relationships Between Critical Thinking and Epistemic and Ontological Cognition
Although they are distinct constructs (King & Kitchener, 2004), EOC and critical thinking may be related. For example, EOC could underlie the inclination, or disposition, to think critically. Facione, Facione, and Giancarlo (2000) describe a critical thinking disposition called *truth seeking,* which involves pursuing the best knowledge and evaluating new information. An individual with naïve EOC would be unlikely to recognize the need to engage in truth seeking, believing that knowledge is simple and unchanging and that it can be provided by an omniscient authority such as a textbook or fieldwork supervisor. *Maturity of judgment* is a disposition that allows recognition of multiple potential answers to a problem and consideration of contextual factors when choosing solutions. To exercise maturity of judgment, one must appreciate the tentative and contextual nature of knowledge. Looking to an authority figure for one right answer to a problem, as in naïve EOC, would prohibit the development of maturity of judgment. Thus, the disposition to think critically could be predicated on EOC.

EOC may also play a role in the development of clinical reasoning in OT. For example, students and novice practitioners tend to focus on knowledge that may be considered simpler and more certain (e.g., the client's diagnosis and procedures used in intervention) when thinking about practice problems (Mattingly & Fleming, 1994; Unsworth, 2001). Novices indiscriminately apply procedures and rules that govern a particular aspect of practice and are unable to recognize situations in which an exception to the rule is in order (Unsworth, 2001). This approach to professional reasoning is logical if knowledge is considered certain and simple and imparted by authority figures.

By contrast, experts are more proficient at considering the client's current and future contexts and reasoning using multiple sources of complex, integrated knowledge. Experts recognize the volume of information to consider in making clinical decisions, when to use critical thinking versus memorization, and that there is more than one

potential solution to an occupational performance problem (Bromme, Pieschl, & Stahl, 2010; Mattingly & Fleming, 1994). Expert reasoning requires sophisticated EOC, i.e., a view of knowledge as complex and integrated and dependent on evaluation of multiple sources of information.

It therefore seems possible that an OT's EOC could influence his or her approach to practice. For example, practitioners with a certain and simple view of knowledge (i.e., naïve ontological cognition) might seek standard protocols and expect "cookbook" answers to clinical problems. Once the one "right" answer has been identified, the need to engage in critical thinking to determine the best solution in the particular context is curtailed. On the other hand, practitioners with a tentative and integrated view of knowledge are more likely to consider multiple variables and formulate the best solution to a practice problem based on the context. Practitioners who rely on experts for answers to clinical problems (i.e., those with naïve epistemic cognition), may see little need to think critically about a problem or situation, as opposed to practitioners who consider multiple sources of information to approach problems in a manner that is customized to individual clients and their contexts, needs, and values. Although EOC could influence the approach to critical thinking in OT, there is little research examining relationships between critical thinking and EOC in general, much less in OT.

Research in Other Disciplines
Two early studies (Brabeck, 1983; Mines, King, Hood, & Wood, 1990) investigated relationships between EOC and critical thinking and found moderate correlations between the two in samples of high school seniors to graduate students. Critical thinking skills such as interpretation, evaluating arguments, deduction, and making inferences distinguished between developmental stages of EOC (Mines et al., 1990). More recently, Chan, Ho, and Ku (2011) studied Chinese undergraduates and found that a belief in certain knowledge was most strongly related to critical thinking. They recommended further research in different cultural contexts and longitudinal research to examine relationships over time.

The current study answers Chan et al.'s (2011) call for longitudinal research investigating relationships between EOC and critical thinking over time. It is also unique in that it involved OT students who are required to solve problems with more than one potential solution, the types of problems that require more sophisticated EOC and high levels of critical thinking (Chan et al., 2011; Mitchell, 2013b). This study utilized measures of both domain-general and OT-specific EOC and explored changes in domain-general EOC, OT-specific EOC, and critical thinking over time. Research questions included: 1) Does EOC (domain-general or OT-specific) predict critical thinking in OT students? 2) How does OT students' EOC (domain-general or OT-specific) change over the course of the didactic portion of an OT program? 3) What is the developmental trajectory of domain-general and OT-specific EOC in this sample of OT students? 4) How does OT students' critical thinking change over the didactic portion of an OT program?

METHODS

A pretest-posttest design was used, and multiple regression models were constructed to examine relationships between EOC and critical thinking. The university's institutional review board granted approval for the study, and all participants provided informed consent.

Participants and Setting

Participants were entry-level Master of OT students on a health science center campus in the midsouth region of the United States. Entry into the program requires at least 90 credit hours of prerequisites. An undergraduate degree is optional; therefore, students may or may not have earned a bachelor's degree. Three cohorts of OT students were invited to participate, although some chose not to volunteer.

Students completed the instruments in a classroom setting during orientation week of the program and online at the end of 18 months of didactic coursework. The modified Four-Quadrant Scale (mFQS) was not administered to the first cohort (see Figure 1). During the study, the students completed 66 credit hours of basic science and OT coursework, including three 2-week Level 1 fieldwork experiences. Level 2 fieldwork (three 12-week experiences) occurred after the didactic portion of the program.

Instruments

Table 1 presents the instruments used to measure the EOC and critical thinking constructs and the specific variables analyzed. Descriptions of the instruments are as follows: The Epistemic Beliefs Inventory (EBI; Schraw, Bendixen, & Dunkle, 2002) is a 32-item Likert scale measuring the dimensions of Certain Knowledge, Quick Learning, Simple Knowledge, Omniscient Authority, and Fixed Ability. Participants rate the strength of their beliefs in statements such as "When someone in authority tells me what to do, I usually do it" (Omniscient Authority factor) on a scale of 1 (strongly disagree) to 5 (strongly agree). The Simple and Certain Knowledge factors were combined and used as dependent variables, in addition to the Omniscient Authority factor. Psychometric properties of the EBI include: internal consistency reliability ranging from .50 to .65, test–retest reliability ranging from .62 to .81, modest but significant predictive validity for reading comprehension, and the ability to explain around 40% of sample variance. Prior research demonstrated the construct validity of the EBI factors (Schraw et al., 2002).

The modified Four-Quadrant Scale (mFQS) is a measure of students' beliefs about knowledge and knowing in the domain of OT. Based on Schraw and Olafson's (2008) Four-Quadrant Scale (FQS), it asks students to rate the strength of their OT-related ontological cognition by placing a mark on a 150-millimeter horizontal axis (Ontological Worldview) and the strength of their OT-related epistemic cognition by placing a second mark on a 150-millimeter vertical axis (Epistemic Worldview). The 0 mark represents the most naïve beliefs, and the 150-millimeter mark represents the most sophisticated beliefs. Although no reliability or validity evidence has been published for the FQS, Schraw and Olafson (2008) tested the scale with practicing teachers and found a statistically significant positive relationship between their Ontological Worldview and Epistemic Worldview scores, as predicted.
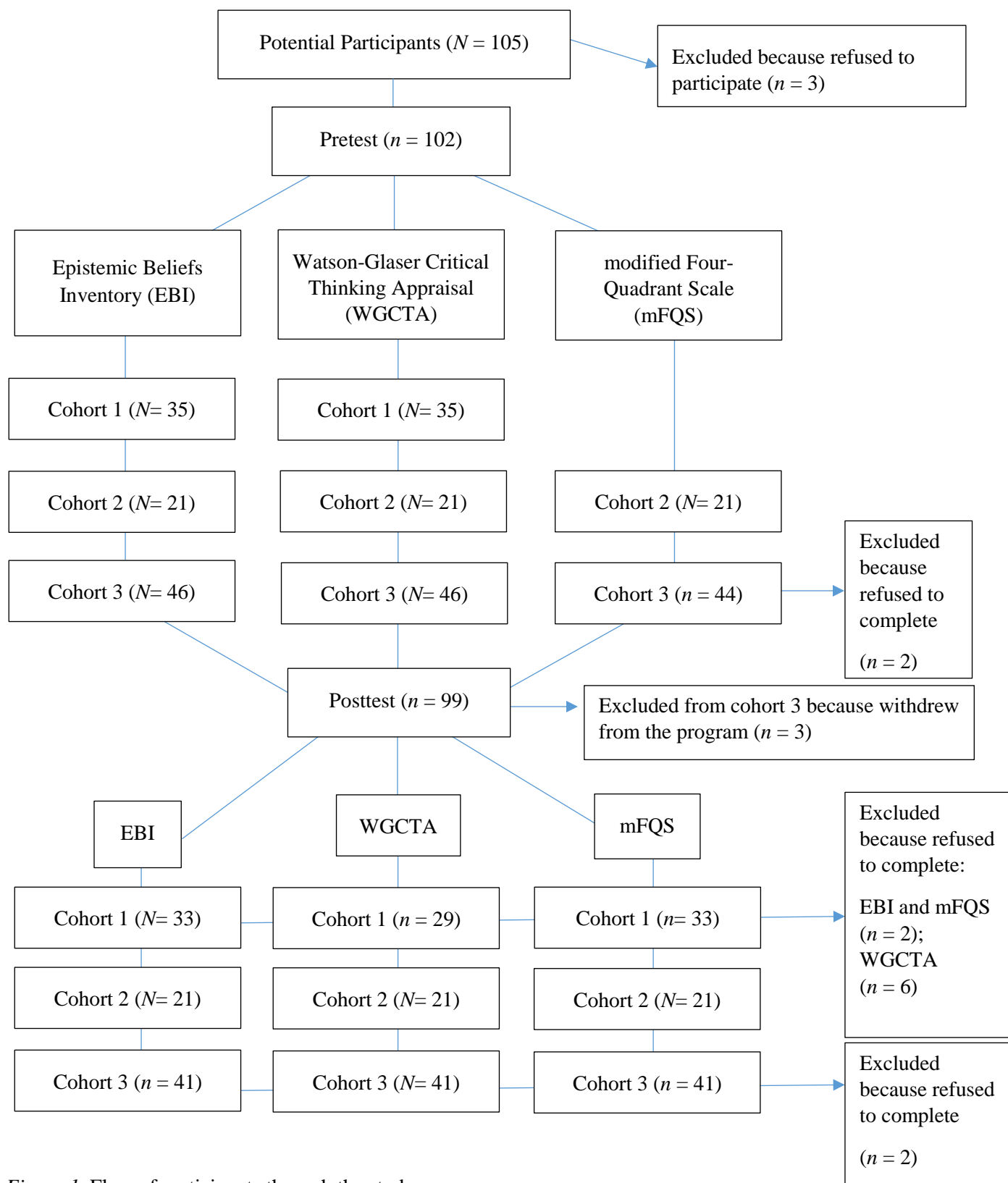
Figure 1. Flow of participants through the study.

The Watson-Glaser Critical Thinking Appraisal (WGCTA; Watson & Glaser, 1980) is an 80-item test with five subscales assessing Inference, Recognition of Assumptions, Deduction, Interpretation, and Evaluation of Arguments. A total score and subscale scores can be determined. Psychometric properties include: internal consistency based on split-half reliability ranging from .69 to .85, test–retest reliability of .73, and alternate-form reliability of .75. Studies have found no consistent gender differences in scores (Watson & Glaser, 1980).

Table 1

Operational Definitions of Constructs

Instrument	Construct Measured	Variables Representing Constructs
Epistemological Beliefs Inventory (EBI)	Domain-general ontological cognition	Simple and certain knowledge (SCK; ontological cognition)*
	Domain-general epistemic cognition	Omniscient authority (OA; epistemic cognition)*
Modified Four-Quadrant Scale (mFQS)	OT-specific ontological cognition	Ontological worldview (OW; ontological cognition)**
	OT-specific epistemic cognition	Epistemic Worldview (EW; epistemic cognition)**
Watson-Glaser Critical Thinking Appraisal (WGCTA)	Critical thinking	WGCTA total scores

*Lower scores indicate more sophisticated beliefs.

**Higher scores indicate more sophisticated beliefs.

Procedure
The EBI, mFQS, and WGCTA (Form A) were administered to all students in a classroom setting during the first week of the OT program and within two weeks of the end of the didactic coursework (i.e., after 18 months in the program, before level 2 fieldwork). Form B, an equivalent form to Form A of the WGCTA, was utilized for the post-didactic testing in order to avoid testing bias. There were no time limits for the EBI or mFQS, and students were assured both verbally and in the written instructions that there were no right or wrong answers. The mFQS was added to the pre- and post-didactic procedures for cohorts 2 and 3 and the post-didactic procedures for cohort 1 in order to collect data related to OT-specific EOC (see Figure 1). Of the two EOC

measures, the EBI was administered first, followed by the mFQS, but the order of administration of these two instruments was counterbalanced with the administration of the WGCTA.

Data Analysis
Descriptive statistics were generated for all demographic and instrument domains. To study the association between EOC and critical thinking, the critical thinking outcome variable, WGCTA, was divided into higher and lower categories, as has been done in previous studies (Trolian, An, & Pascarella, 2016). The cut-point was established at the pre-didactic WGCTA median score; scores ≤ 55 were considered low and scores > 55 were considered high. Logistic regression was used to determine odds ratios (OR) and 95% confidence intervals (CI). The variables gender, degree, degree type [Science, Technology, Engineering, or Mathematics (STEM) vs. non-STEM], and order of test administration were examined as potential effect modifiers and confounders. Effect modification was assessed by the inclusion of a multiplicative interaction term, and potential confounding was assessed using the change-in-estimate criteria. The variables were entered into the model one at a time, and if the variable changed the measure of association between the primary predictor variable and the outcome by more than 10%, it was retained in the model.

To study the developmental trajectory of domain-general and domain-specific ontological cognition and epistemic cognition, paired *t*-tests were used to measure differences in mean scores on the Simple and Certain Knowledge and Omniscient Authority variables from the EBI and differences in mean scores on the Ontological Worldview and Epistemic Worldview variables from the mFQS at the beginning and end of the didactic portion of the program. Paired *t*-tests were also used to measure changes from the start to the end of the didactic portion of the program for each of the five EOC and critical thinking variables.

RESULTS
One hundred two of the 105 potential participants completed the EBI and WGCTA pretests, and 65 of the 70 potential participants from cohorts 2 and 3 completed the mFQS pretest. Three students from cohort 3 withdrew from the program before post-didactic data was collected. Ninety-five students completed both the pre-didactic and post-didactic EBI; 65 students in cohorts 2 and 3 completed both the pre- and post-didactic mFQS; and 91 completed both the pre- and post-didactic WGCTA. Thirty additional students from cohort 1 completed the post-didactic mFQS (see Table 2 and Figure 1). The mean ages of the participants were 23.4 at pretesting (range = 20-41) and 24.4 at posttesting (range = 21-42). Additional characteristics of the participants are reported in Table 3.

Table 2

Descriptive Statistics for Epistemic and Ontological Cognition and Critical Thinking Variables

Variable		N	Mean (Std Dev)	Range
SCK (EBI)	Pre-didactic	102	41.6 (5.4)	24-55
	Post-didactic	95	39.9 (5.7)	24-55
OA (EBI)	Pre-didactic	102	16.8 (3.0)	9-23
	Post-didactic	95	16.3 (2.8)	9-22
EW (mFQS)	Pre-didactic	65	107 (30.7)	0-149
	Post-didactic	95	111 (30.6)	10-150
OW (mFQS)	Pre-didactic	65	104 (33.3)	23-150
	Post-didactic	95	122 (31.3)	0-150
WGCTA	Pre-didactic	102	54.3 (8.4)	36-73
	Post-didactic	91	55.0 (8.2)	33-75

Note: SCK = Simple and Certain Knowledge; EBI = Epistemic Beliefs Inventory; OA = Omniscient Authority; EW = Epistemological Worldview; mFQS = modified Four Quadrant Scale; OW = Ontological Worldview; WGCTA = Watson-Glaser Critical Thinking Appraisal.

Table 3

Participant Characteristics

		N (%)
Gender	Male	15 (15)
	Female	87 (85)
Ethnicity	African-American	6 (6)
	Asian	4 (4)
	Multiracial	1 (1)
	White	91 (89)
Degree	Bachelor's	48 (47)
	None	51 (50)
	Associate's	3 (3)
STEM Degree	Yes	30 (30)
	No	70 (70)

Of the four independent variables tested—Simple and Certain Knowledge, Omniscient Authority, Epistemic Worldview, and Ontological Worldview—only Omniscient Authority was a statistically significant predictor of critical thinking (see Table 4). Pre-didactic Omniscient Authority was a predictor of post-didactic critical thinking (OR = 0.85; 95% CI: 0.72, 0.99; $p = 0.043$), showing a 15% decrease in the odds of being in the upper 50th percentile of critical thinking for every one-point increase in score (Higher scores indicate stronger beliefs in an omniscient authority as a source of knowledge.). Also, post-didactic Omniscient Authority was a predictor of post-didactic critical thinking (OR = 0.81; 95% CI: 0.68, 0.96; $p = 0.016$), with a 19% decrease in odds of being in the upper 50th percentile for every one-point increase in score (indicating stronger beliefs in an omniscient authority as a source of knowledge). Higher Omniscient Authority scores were associated with lower critical thinking skills, as expected. No interaction or confounding were discovered.

Table 4

Association between Epistemic and Ontological Cognition Variables and Critical Thinking

Outcome Variable	Input Variable	Odds ratio (95% CI) of High CT vs Low CT	*p*-value
Pre-didactic CT	Pre-didactic SCK	0.93 (0.86, 1.01)	0.077
	Pre-didactic OA	0.90 (0.79, 1.03)	0.121
	Pre-didactic EW	1.01 (0.99, 1.02)	0.553
	Pre-didactic OW	0.99 (0.98, 1.01)	0.319
Post-didactic CT	Pre-didactic SCK	0.95 (0.88, 1.03)	0.241
	Pre-didactic OA	0.85 (0.72, 0.99)	0.043
	Pre-didactic EW	1.00 (0.98, 1.02)	0.986
	Pre-didactic OW	0.99 (0.97, 1.01)	0.177
Post-didactic CT	Post-didactic SCK	0.99 (0.92, 1.07)	0.852
	Post-didactic OA	0.81 (0.68, 0.96)	0.016
	Post-didactic EW	1.00 (0.99, 1.02)	0.620
	Post-didactic OW	1.01 (0.99, 1.02)	0.498

Note: SCK = Simple and Certain Knowledge; OA = Omniscient Authority; EW = Epistemological Worldview; OW = Ontological Worldview; CT = Critical Thinking.

The domain-general ontological cognition score was lower (more sophisticated) than the domain-general epistemic cognition score at both points in time (pre-didactic: $t(101) = -13.22$, $p < .001$; post-didactic: $t(94) = -10.639$, $p < .001$). There were no statistically significant differences in OT-specific epistemic cognition or ontological cognition at entry into the program (pre-didactic: $t(64) = .478$, $p = .634$), but post-didactic OT-specific ontological cognition scores were higher (more sophisticated) than OT-specific epistemic cognition scores ($t(93) = -3.166$, $p = .002$).

The pre- and post-didactic results showed that both domain-general variables, Simple and Certain Knowledge (mean difference = -1.50, $p < 0.001$) and Omniscient Authority (mean difference = -0.54, $p = 0.036$), and the OT-specific Ontological Worldview variable (mean difference = 17.19, $p = 0.005$) became more sophisticated over time. The OT-specific Epistemological Worldview variable (mean difference = 4.22, $p = 0.421$) and the critical thinking variable, WGCTA, (mean difference = 0.81, $p = 0.323$), did not.

DISCUSSION

In this study, students who began the program with stronger general beliefs in an omniscient authority as the source of knowledge were more likely to have lower critical thinking skills at the end of the program. This more naïve epistemic cognition was also associated with lower critical thinking scores at the end of the program. Aspects of general ontological cognition (beliefs in simple and certain knowledge) were not associated with critical thinking, nor were any OT-specific aspects of EOC.

Relying on answers from an omniscient authority may restrict critical thinking. Whether the authority is a recognized expert, textbook, experienced colleague, or research evidence, belief in an omniscient authority may preclude consideration of knowledge from multiple sources—including the client and the context—when determining a logical solution to a practice problem. Therapists with naïve epistemic cognition may have a skewed perception of evidence-based practice, seeking research evidence to determine their approach to practice, when the evidence may be more appropriately used to inspire, enlighten, or inform practice decisions (Aas & Alexanderson, 2012). Occupational therapy practice demands use of multiple sources of knowledge, with the client's needs, values, and contexts paramount (Mitchell, 2013b). As anticipated, in this study, students with more sophisticated epistemic cognition exhibited higher levels of critical thinking and would presumably be more effective problem-solvers.

Unlike this study, Chan and colleagues (2011) found that general beliefs in certain knowledge (i.e., ontological cognition) were the most prominent predictor of critical thinking in their sample of Chinese undergraduates from a variety of programs. Differences in findings may be related to the different instruments used to measure critical thinking and to the fact that Chan and colleagues did not include the Omniscient Authority factor of the EBI in their analyses. Cultural factors and other sample differences may have also contributed to these inconsistencies.

As predicted by Greene and colleagues' (2008, 2010) theoretical model, general ontological cognition appeared to develop prior to general epistemic cognition, as this sample of OT students demonstrated more sophisticated ontological cognition than epistemic cognition at both points in time. In fact, the mean EBI scores on the Simple and Certain Knowledge variable were below the median score of 3 on the 5-point scale at both pre- and post-testing, while scores on the Omniscient Authority variable were above the median score of 3 on the 5-point scale at both pre- and post-testing. As Greene et al. (2008) conjectured, it may be unusual for an individual to have naïve ontological cognition and at the same time hold sophisticated beliefs about the source of knowledge. These results are also consistent with Mitchell's (2015) findings that general ontological cognition was more sophisticated than general epistemic cognition at the beginning, middle, and end of the didactic coursework in an OT program. Although their epistemic cognition became more sophisticated over the course of this study, students continued to hold relatively strong beliefs in an omniscient authority as a source of knowledge at the post-didactic testing. Similar to Muis and Duffy's (2013) study of changes in EOC following a constructivist versus standard teaching approach, belief in an omniscient authority appeared to be the last dimension of EOC to change.

In the current study, the EBI Omniscient Authority mean scores remained above the median of 3 on the 5-point scale; however, the scores did become significantly more sophisticated. It is possible that students may have extended their beliefs about the types of authoritative sources of knowledge, but this cannot be determined based on the quantitative data collected for this study. Coker (2010) found that students who participated in an experiential learning program increased their reliance on their personal experiences when making practice decisions, suggesting that fieldwork experiences could be more effective than didactic coursework for facilitating shifts in epistemic cognition.

As with general EOC, OT-specific ontological cognition appeared to develop before OT-specific epistemic cognition. At the beginning of the OT program, there was no statistically significant difference between the students' OT-specific EOC, but after 18 months of didactic work, OT-specific ontological cognition had increased in sophistication, whereas OT-specific epistemic cognition had not. These findings suggest a developmental trajectory, with OT-specific beliefs developing from domain-general beliefs (Buehl & Alexander, 2006; Hofer, 2006). While causal inferences cannot be made from this data, it is possible that a certain level of domain-general EOC was necessary to support development of OT-specific ontological cognition. Weakening general beliefs in the certainty and simplicity of knowledge and an omniscient authority as the source of knowledge may position students to be more open to the belief that knowledge in OT is not simple or certain. Rigorous education in the domain of OT may have facilitated convergence of OT-specific ontological cognition and domain-general EOC (Muis et al., 2006), with OT-specific beliefs in an omniscient authority as the source of knowledge being more resistant to change.

The fact that this sample of students demonstrated fairly sophisticated general ontological cognition may help explain why only the EBI Omniscient Authority factor was associated with critical thinking skills. Perhaps a larger sample including individuals with less sophisticated ontological cognition might have allowed detection of links between ontological cognition and critical thinking. A more fine-grained analysis of relationships with the specific aspects of critical thinking could have also been possible.

In this study, no statistically significant change was observed in critical thinking skills over the course of classroom instruction. This runs counter to Vogel and colleagues' (2009) findings, despite the fact that both studies utilized the WGCTA as an outcome measure and that the current study had a larger sample and therefore greater power to detect differences. One explanation could be differences in the curricula themselves. Although both curricula included similar teaching techniques—for example, small group discussion and problem-solving and case studies—problem-based learning was not used by the curriculum in the current study, nor was critical thinking as a process taught early in the curriculum.

Implications for Occupational Therapy Education

Awareness of the relationship between beliefs in an omniscient authority as the source of knowledge and critical thinking may assist educators in preparing OT students to think critically when solving occupational performance problems. Facilitating use of multiple sources of knowledge could promote movement away from a belief in an omniscient authority as the source of knowledge and support more skilled critical thinking. Using constructivist techniques such as reflection, debate, explicit evaluation of their own thinking, discussion, and case-based instruction (Bromme et al., 2010; Chan et al., 2011; Coker, 2010; Muis & Duffy, 2013) may act as a catalyst for change in students' EOC by leading them to question their beliefs about knowledge (Chan et al., 2011; Hofer, 2004) and at the same time foster critical thinking (Coker, 2010). As students are enculturated into the profession of OT and begin to value the profession's theoretical foundations and ways of knowing, students' EOC may be expanded and their critical thinking enhanced (Ikiugu & Smallfield, 2015; Muis et al., 2006; Muis & Duffy, 2013).

Limitations

One limitation of this study was the relatively small convenience sample with limited power to detect small differences. Larger samples could also have allowed for a more fine-grained analysis using individual subtest scores on the WGCTA. The pretest-posttest design may have also introduced biases such as regression to the mean or test bias; however, equivalent versions of the WGCTA were used at pre- and post-testing, and the fact that the posttests were administered 18 months after the pretest may have mitigated test bias. Further, the WGCTA is a domain-general measure that may not be the most appropriate instrument for detecting changes in OT-specific critical thinking. Generalization of these results is also limited by the study of a small convenience sample from one OT program.

Suggestions for Future Research

Inclusion of an OT-specific measure of critical thinking could allow detection of changes in OT-specific critical thinking and provide further insight into the relationships between EOC and critical thinking in the specific context of OT. Larger studies and cross-institutional research could also help clarify aspects of curricula that assist in developing EOC and critical thinking in OT students. Coker's (2010) findings that an experiential learning program resulted in increased tolerance for uncertainty and ambiguity and greater reliance on personal experience for making practice decisions suggest that studies of changes in EOC and critical thinking over the course of Level 2 fieldwork experiences may be enlightening.

Conclusion

This study suggests that EOC, specifically belief in an omniscient authority as the source of knowledge, predict critical thinking and that change in ontological cognition occurs before the development of epistemic cognition. Domain-general beliefs also appeared to develop before domain-specific beliefs. As students are enculturated into the profession, they may benefit from constructivist approaches that emphasize OT's theoretical underpinnings and ways of knowing and facilitate development of more

sophisticated EOC, the type of EOC that characterizes effective practitioners. Acknowledging that more than one source of knowledge can be used to reason and develop solutions to practice problems may also promote the critical thinking needed for successfully addressing clients' occupational performance issues. Aspects of EOC may, in fact, be a foundation for critical thinking. Educators who understand and foster the development of EOC may have greater success at enhancing critical thinking.

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