Connecting to the Future: A Revised Measure of Exogenous Perceptions of Instrumentality

by

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ABSTRACT

The primary objective of this study was to revise a measure of exogenous instrumentality, part of a larger scale known as the Perceptions of Instrumentality Scale (Husman, Derryberry, Crowson, & Lomax, 2004) used to measure future oriented student value for course content. Study 1 piloted the revised items, explored the factor structure, and provided initial evidence for the reliability and validity of the revised scale. Study 2 provided additional reliability evidence but a factor analysis with the original and revised scale items revealed that the revised scale was measuring a distinct and separate construct that was not exogenous instrumentality. Here this new construct is called extrinsic instrumentality for grade. This study revealed that those that endorse a high utility value for grade report lower levels of connectedness (Husman & Shell, 2008) and significantly less use of knowledge building strategies (Shell, et al., 2005). These findings suggest that there are additional types of future oriented extrinsic motivation that should be considered when constructing interventions for students, specifically non-major students. This study also provided additional evidence that there are types of extrinsic motivation that are adaptive and have positive relationships with knowledge building strategies and connectedness to the future. Implications for the measurement of future time perspective (FTP) and its relationship to these three proximal, future oriented, course specific measures of value are also discussed.

DEDICATION

To my children, Eli, Payton, and baby #3

May you always have a hunger for knowledge and desire to make the world a better place.

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The completion of this work would never have been possible without the support of many people.

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CHAPTER 1

INTRODUCTION

Post-secondary education is important. It is where and how we learn the skills that we need to pursue the careers that interest us. There are many subjects or lessons that have an obvious and direct connection to our careers, but as a novice learner in any given area, there are times when we don't see the connections between what we are learning and how it is useful for our future. Students look at these courses as things they have to learn or pass that have little value for their futures. For example, many engineering students don't see the value in learning calculus principles or family and human development majors the value of statistics.

Many researchers have attempted to both explain and/or solve this problem. Behavior theorists view motivation in general as the rate or likelihood of behavior and as such would likely frame this problem in terms of performance and not attend to what the student is necessarily thinking about what they are learning. That is, if the student is performing well on class assignments and exams, there is no issue. If a student was performing poorly however, a chance in their environment or a particular stimulus may be needed to make the poor performance less likely to continue to occur (Skinner, 1953). This doesn't really help us with the idea of what students value though.

Moving more towards a cognitive model of motivation, theorists using Atkinson's achievement motivation theory would reframe the question in terms of each student's desire for success versus their fear of failure (Covington, 2000). Students that have a high approach to success and low fear of failure are likely to be mastery oriented and find value in courses on their own terms. Students high in approach to success as well as high in failure avoidance are likely to perseverate on and stress over their final grade, but not necessarily attend to what they are getting out of the course. Students low in both motivation to succeed as well as fear of failure are indifferent to success or failure due to either lack of concern or active anger and resistance to achievement. Students low in need for achievement but high in fear of failure will avoid putting

themselves in stations where they won't do well or procrastinate or use self-handicapping strategies. Although this theory is useful in describing internal and personal contributions to motivation, Atkinson also acknowledged that there were environmental aspects that were task specific that needed to be attended to that his theory did not initially address (Weiner, 1992). While Atkinson continued research into these missing pieces, other researchers had also come to the same conclusion and a new theory emerged. This body of research is known as Expectancy Value theory.

CHAPTER 2

LITERATURE REVIEW

Expectancy-Value Theory. Expectancy-Value theorists (Atkinson, 1957; Wigfield & Eccles, 1992; Eccles & Wigfield, 1995) use a two-pronged approach to understand why student's value for a given learning activity may vary. The first step is to understand the judgements a student makes about themselves and their ability to perform well on a specific task. This is expectancy. The second is to understand the beliefs that students have about why they engage in those tasks. This is value. The expectancy and value assessments that a student makes in any given situation impact the other. For example, if I have very high value for completing my dissertation but very low expectancy for being able to do so (perhaps I don't have the requisite writing skills) then I am likely to run in to some problems. Atkinson's proposed that these constructs were inversely related, however Wigfield and Eccles (1992) posited that motivation is the product of the expectancy for success *times* the value of the task, and that achievement-related behaviors are influenced by the connection between expectancy for success and subjective perception of task value. Therefore, students are more likely to value tasks that they do well at *and* they have value for (Wigfield, 1994). It also explains that students are more likely to invest more effort and achieve at higher levels when they perceive the tasks as having great deal of personal importance or relevance, even when the tasks may not be intrinsically interesting.

Researchers have reported that value perceptions, specifically those that are not intrinsic, are positively related with various motivational outcomes such as interest, tack choice, and future course enrollment (Bong, 2001; Wigfield, 1994).This theory has been well tested in academic settings, specifically with upper elementary and middle school students and found that students reported expectancy for success in specific subjects over time are good predictors of academic success (Wigfield & Eccles, 1992; Hulleman, Kosovich, Barron, & Daniel, 2016).

As research in this area has progressed different types of value have emerged in the literature. The four types of value that Eccles and Wigfield (1995) identify are intrinsic value, the perceived importance of a task because of its inherent enjoyment or interest; attainment value, the perceived importance of a task for an individual's identity and self-worth; utility value, the

perceived importance or usefulness of a task for accomplishing future goals; and cost value, the perceived negative aspects of engaging in a task (e.g., amount of time consumed). It should be noted that while utility value, originally defined as “the value a task acquires because itis instrumental in reaching a variety of long- and short-range goals” (Eccles & Wigfield, 1995, p. 216), the items used to measure utility value do not actually have an explicit future orientation (eg, How useful is what you learn in advanced high school math for your daily life outside school?). This will be discussed later, but is an important consideration for the discussion about future time perspective. Additional research has indicated that utility value can be further parsed out into separate and distinct constructs as well (Husman, Derryberry, Crowson, & Lomax, 2004). This is where the research on expectancy value intersects with the research on future time perspective to give us give us a more holistic understanding of the concept of utility value and its dimensions.

Future Time Perspective. Motivation at its core is goal directed and sustained behaviors. While Lewin (1942) defined a person’s time perspective (TP) as including a person’s total view of time including their psychological past, present and concept of the future, Future Time perspective, or FTP is inherently future oriented because we cannot have goals for our past. Future Time Perspective Theories explain how individual perceptions and anticipations of their future goals affect their motivation for the current task at hand (Husman & Lens, 1999; Zimbardo & Boyd, 1999; Lang & Carstensen, 2002; Malka & Covington, 2005). FTP can be considered a domain general variable. It is a person’s global view of their imagined future and is measured in four dimensions. Speed is the pace at which people perceive time to pass. The ability to plan for the future has been linked to a strong FTP, and strong FTP has been linked with academic success (Husman & Lens, 1999). Distance is how far in to the future one has goals and plans for. This is considered to be a person’s time horizon or time bubble (Husman, Duggan, & Fishman, 2014). The more life goals one has and the further out in to the future these goals extend, the closer and more important those goals will seem (Tucker, Vuchinich, & Rippens, 2002). Valence is the value or importance a person places on an event or goal (De Volder & Lens, 1982).

Research on valence has shown that it is positively correlated with adaptive behaviors and positive motivation in educational settings (Shell & Husman, 2001;Turner & Schallert, 2001).

Lastly, and of specific interest here is connectedness or perceived instrumentality, which is defined as the general capacity of an individual to make cognitive connections between their constructed present and anticipated future (Bembenutty, 2009; Bong, 2001; Husman, Derryberry, Crowson, & Lomax, 2004; Simons, Dewitte, & Lens, 2004). Each of these dimensions of FTP have been well researched in regards to their contributions to or impact on an individual's academic achievement at a domain-general level. Connectedness specifically has been shown in previous studies to be a predictor of student achievement in postsecondary classrooms (Shell & Husman, 2001).

Future time perspective research, similar to many theories of motivation, can be measured at different analytical levels: local, domain general, global (Hilpert, et al., 2012). At the most local level lies students' perceived future value for specific tasks (Simons, Dewitte, & Lens, 2004). At the domain and global levels lies how connected students feel to the future, either for a specific domain such as engineering or for the future in general (Tabachnick, Miller, & Relyea, 2008; Hilpert, et al., 2012). This is the Connectedness dimension of FTP. Perceptions of instrumentality is a more proximal and domain-specific measurement of the connectedness dimension that have also been used to explain students' choice of learning strategies and predict academic outcomes (Miller & Brickman, 2004).

Endogenous and Exogenous Instrumentality.

The belief that a present task is useful and important for an individual's future success even though one may not find the task inherently interesting or motivating makes instrumentality a type of extrinsic motivation (Lens, Paixão, & Herrera, 2009). Prior research on Instrumentality indicates that there are two related sub-components and that they are context dependent. Endogenous instrumentality is the perception that learning or mastering new information or concepts is useful to achieving long-term future goals (Husman, Derryberry, Crowson, & Lomax, 2004). This type of instrumentality focuses on learning and mastering the content or task at hand, with an understanding that the task or content itself is important, much akin to Atkinson's mastery

orientation mentioned earlier (Weiner, 1992). In contrast, exogenous instrumentality is the perception that the completion of a task or attainment of an external reward is instrumental to achieving a future goal (Husman, et al., 2004). This type of instrumentality is useful only for jumping hurdles or checking items off a list that are required for another goal. It is extrinsic and performance motivated, though still future oriented. As one would anticipate, these two different orientations towards value of a task have very different impacts on the knowledge building strategies that students engage in to achieve their goals.

Instrumentality plays an important role in interest, which is important for learning and the use of optimal knowledge building strategies. Hidi and Renninger (2006), propose a four-phase model of interest development, spanning from situational interest to individual interest. Situational interest is interest that is generated by an interaction between a person and a specific situation or condition. Individual interest is interest that is a relatively long-lasting, personal disposition (Hidi & Renninger, 2006). At the very first stage, perceived instrumentality can trigger short-term interest in a specific situation, and this situational interest can develop into individual interest over time (Hulleman, Godes, Hendricks, & Harackiewicz, 2010) Therefore, instrumentality perceptions may play a critical role in the beginning stages of interest development as well as in the deepening of individual interest over time (Hulleman, Durik, Hendricks, & Garackiewicz, 2010). Hulleman et al. (2010; 2016) showed that interventions that increases a student's understanding of relevance of a specific topic had positive effect on situational interest and utility value.

Research on student motivation indicates that when students have no endogenous instrumentality for the content they are learning they interact with the content differently. Students that are unable to link the content to their future goals outside of getting a passing grade do not fully utilize optimal knowledge building strategies. Instead of trying to learn the content, connect it to their current knowledge base, and have a deeper understanding of why it is important to understand those principles, they skim through the content attempting to retain enough information to pass a quiz or exam and then soon after forget what they "learned" (Simons, Dewitte, & Lens, 2004; Miller & Brickman, 2004). While each of these components of PI promote variable use of knowledge building strategies, they are none the less both future oriented.

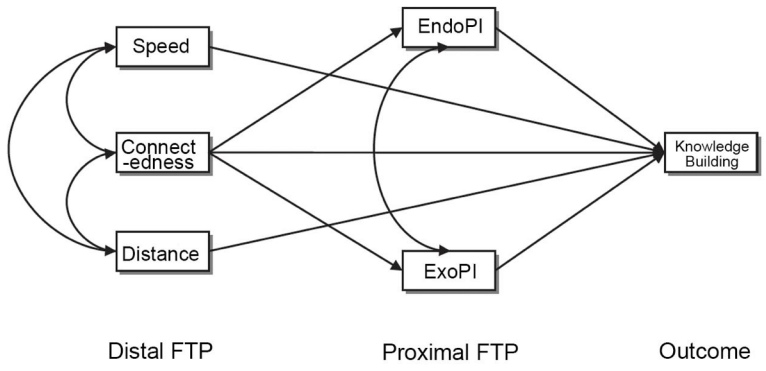
The future time orientation of this type of instrumentality, as well as the ability to measure it, is of specific importance for many reasons. Research has shown that a student's ability to link academic tasks to future goals is important not only for their learning of course content, but also of their persistence in college (Miller, DeBacker, & Greene, Perceived instrumentality and academics: The link to task valuing, 1999) and that PI increases intrinsic motivation which is also useful for learning (Husman, Derryberry, Crowson, & Lomax, 2004; Lens, 2002). If something is beneficial to student motivation to learn, use of knowledge building strategies, academic achievement, and persistence in degree attainment, it is worth studying. Research on how to increase students' endogenous instrumentality of content has also yielded useful information. We know that students respond better to coping models than they do expert models giving them information about the value and instrumentality of content (Puruhito, Husman, Hilpert, Ganesh, & Stump, 2011). We also know that prompting students to write about why learning more about a particular topic is important for their future also yields positive results (Harackiewicz, Canning, Tibbetts, Priniski, & Hyde, 2015). Instrumentality and related constructs can be positively impacted by interventions, which may yield to increases in use of optimal knowledge building strategies and academic achievement, so what we now need to discuss is how these constructs are measured.

A Model of Distal and Proximal Future Time Perspective

Research continues to add to our understanding of future time orientation, how constructs are related, and how they impact learning. The current body of literature indicates that there are three components that make up the domain-general structure of future time perspective that can directly influence the use of knowledge building strategies and overall student motivation (Tabachnick, Miller, & Relyea, 2008). These components are connectedness, speed and distance. They do function as separate latent constructs but also influence one another (Husman & Shell, 2008; Malka & Covington, 2005; Shell & Husman, 2001). Perceived instrumentality is a task-specific construct that is influenced by a person's connectedness to their future. This construct has two sub-components, endogenous and exogenous. Both of these sub-components

directly influence students use of self-regulated learning strategies as well as influencing one another. (Simons, Dewitte, & Lens, 2004; Husman & Shell, 2008; Hilpert, et al., 2012). All of the relationships in this model have previously been reported as positive, though not all siginficant or strong, yet still meaninful (Hilpert, et al., 2012). Improvement of this model is the subject of Study 2. The model is provided in Figure 1 for your visual reference.

Figure 1. A Model of Future Time Perspective Pathways to Knowledge Building



A visual representation of the pathways to knowledge building model originally provided in (Hilpert, et al., 2012).

Constructs and Measurement

In order to generate a model of FTP as described above and to measure the success of an intervention, there must be reliable and valid measurement tool for each of the constructs. While a measure for both endogenous (EndoPI) and exogenous perceptions (ExoPI) of instrumentality does exist, there are problems with the exogenous subscale. The endogenous subscale has good reliability and validity evidence (α=.90) (Hilpert, et al., 2012). It has been used to predict success in courses and retention in engineering programs at large universities. The exogenous scale however has performed less well (α=.64) (Hilpert, et al., 2012; Kim, 2016) It had little predictive value and does not correlate well with measures that it theoretically should. While it does factor out as a separate factor when tested, the item loadings leave room for improvement

(ranging from .37-.79 in Hilpert et al., 2012) and it had little predictive value for knowledge building. Most studies conducted in the past few years have dropped the exogenous portion of the scale all together (Puruhito, Husman, Hilpert, Ganesh, & Stump, 2011; Puruhito, Hilpert, Duchrow, Banegas, & Husman, unpublished). Hence the need for revision and revalidation.

Theoretically, the exogenous subscale should add to the predictive value of the complete PI scale, above and beyond what the endogenous subscale does. It should also correlate with use of knowledge building strategies, and the more distal, global measures of future time perspective, connectedness. Jenefer Husman, Duane Shell, and I worked together to improve the scale with this in mind. We met and worked through the theoretical issues with the current subscale and discussed how to improve upon the wording to better measure what it theoretically should. The original and new versions are provided in Table 1 for reference. It is worth mentioning that negatively worded items were reworded and specificity was added so that questions can be adapted to include course name. The new scale is now ready for validation. Validating this scale will allow for it to be used in future research studies that will provide us an opportunity to fine tune the model of distal and proximal components of future time perspective for use in better understanding, explaining, and evaluating student motivation, regulation, academic success and retention, as well as efficacy of interventions.

Table 1

Original and Revised versions of the Exogenous Perceptions of Instrumentality Sub-scale.

Scale Items	Original	Revised
1	I must pass this class in order to reach my academic goals.	The only aspect of {insert course name} that will affect my academic future is my grade.
2	The grade I get in this class will affect my future.	The only thing useful to me in {insert course name} is the grade I get.
3	The grade I get in this class will not affect my ability to continue on with my education	The only aspect of this class that will matter after graduation is my grade.
4	What grade I get in this class will not be important for my future academic success.	To reach my academic goals, all I need from this course is my grade.

It is expected that the revised exogenous PI sub-scale will show a measurable improvement over the previous version with correlation to related constructs (Connectedness and knowledge building), and that the full scale factors out 2 factors (endogenous and exogenous instrumentality) and adds to the predictive validity of the overall scale.

CHAPTER 3

STUDY 1

Research Questions

My research questions for study 1 are as follows:

1. Does the revised PI scale conform to the expected factor structure of 2 factors?
2. Does the revised exogenous subscale add to the predictive validity of the PI scale above and beyond the endogenous subscale?

Methods

Participants. Students at a large Southwestern university in the United States were recruited at the beginning of the Spring 2013 semester from psychology, geology and human development introduction course. 244 students from these courses participated. Surveys with incomplete data were removed from the analysis, leaving 220 viable responses for analysis. The sample consists of 38 geology students, 65 human development students, and 117 psychology students. The sample population is 29.5% male (71) and 82.7% female (147). One person (.5%) selected “I prefer not to answer” and 11 people (4.5%) did not provide a response at all. The sample consisted of undergraduate students only and age and ethnicity were not collected.

Procedure. Instructors were asked to post a notice on their respective online course websites about the study. The survey was expected to take approximately 10 minutes of their time. Students that completed the survey electronically were entered in a drawing to win one of 15 - $25 gift cards to Amazon.com to encourage participation.

This method of recruitment was previously used for other data collections and proved to be efficient for both participants and researchers. Those that won were emailed their gift card code. No in person contact after completion of the survey was necessary. This relieved the burden from both the student and the researcher and made the study less effortful for everyone.

Names and emails were immediately separated from data and placed in a separate list that was only be used for distribution of incentives. The website random.org was used to select the 15 participants that received the Amazon gift cards. Data was cleaned coded, and entered

into SPSS and encrypted and password protected and stored in cloud storage. The study was approved by the IRB board at the University and all participants consented to participation prior to taking the online survey.

Measures. The Perceptions of Instrumentality Scale (Husman, Derryberry, Crowson, & Lomax, 2004) is framed by the expectancy value model of motivation (Wigfield & Eccles, 2002) and is a measure of a person's value for future oriented activities. The scale consists of two subscales with 4 items each, the Endogenous (EndoPI) subscale and the revised Exogenous (ExoPI) subscale. This scale is intended to measure a specific tasks importance as it relates to the achievement of a future goal. The endogenous instrumentality subscale consisted of four items (e.g., "What I gain from {insert course name} will shape my future") and the revised exogenous instrumentality subscale consisted of four items (e.g., "The only thing useful to me in {insert course name} is the grade I get"). Alpha coefficients for the original scale were reported at .90 for endogenous and .64 for endogenous (Hilpert et al., 2012). Responses were recorded on a Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree) with an additional option of "I prefer not to answer".

The Future Time Perspective Scale (FTPS) developed by Husman and Shell (2008) is included as a measure of global future oriented thinking. Three of the four subscales, Connectedness (6 items; e.g., "Planning for what I will do after college graduation is a good use of time."), Speed (3 items, e.g., "I always seem to be doing things at the last moment."), and Distance (5 items, e.g., "Half a year seems like a long time to me") were used. This scale measures a person's relative temporal orientation to the past, present and future, how connected they are to the future, and the speed at which they perceive future events moving towards them. Crohnbach alphas of .80 for the Connectedness subscale, .74 for the Distance subscale and .66 for the Speed subscale. All items used a 5 point Likert response scale with a sixth option, "I prefer not to answer." All items are provided in Appendix A.

The Knowledge Building Subscale (KB) from the Student Perceptions of Classroom Knowledge Building (SPOCK) consists of 8 items (e.g., "As I study topics in other classes, I try to think about how they relate to the topics I am studying in {insert course name}") and is used to

measure students perceived use of self-regulated learning strategies (Shell, et al., 2005). Coefficient alphas of .83 &.84 were reported during scale development (Shell, et al., 2005). Responses were recorded on a Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree) with an additional option of “I prefer not to answer”.

Plan of Analysis

One of the aims of this study is to improve upon an existing scale. In order to determine if this was achieved, multiple analyses were run. First, a confirmatory factor analysis was completed to determine if the changes to the wording of the items changed factor loadings. Because the endogenous and exogenous items are related, an oblique rotation was used. This allowed me to examine factor loadings. The literature in this area indicates that there should be two factors. Rotation may help with interpretation and simplifies the factor structure, making interpretation easier and more reliable. Rotating simplifies the interpretation of the analysis because it searches for the rotation that maximizes variance of the loadings. When making a final decision on the number of factors to keep, the literature was also consulted.

Second, I explored the reliability evidence by calculating Cronbach alphas for each measure. Third, multiple types of validity evidence were reviewed. Evidence for content validity was obtained by reviewing the relevance of the content to the construct as well as how well the items cover the content domain. Criterion related validity evidence was obtained by comparing how well the original and revised exogenous subscale correlates with the knowledge building subscale of the SPOCK, which is included in this study. This measure of knowledge building is used for criterion related validity evidence because previous research indicates that it is related to and predicts use of knowledge building strategies. If this revised subscale proves to be an improved measure of exogenous instrumentality, one would theoretically expect to see a more negative correlation between exogenous instrumentality and the knowledge building scale. Evidence for construct validity was explored by looking at how discriminant the endogenous and exogenous PI scales are from one another by reviewing the correlation matrices. Construct Validity was sought in the CFA. An additional source of content validity was reviewed by

exploring the relationship between the revised exogenous subscale and the FTPS-Connectedness Subscale included in this study. This is a known measure of future oriented thinking and measures one's ability to connect what is happening now to their perceived future at a more distal, domain general level. These constructs should correlate with one another but still factor out to distinct constructs.

To determine if the revised exogenous subscale improves upon the overall scale's ability to predict reported use of knowledge building skills, a regression analysis was completed. Since I anticipated that endogenous instrumentality would be a stronger predictor of knowledge building, the exogenous subscale was entered as a second-order variable in the analysis.

CHAPTER 4

RESULTS

The data were cleaned and coded and items that were negatively worded were reverse coded. Cases with missing data were removed from the analyses. Descriptive statistics, provided in Table 2, indicate that the variables were relatively normally distributed. Skew and Kurtosis, both measures of central tendency indicate that the responses were not normally distributed, but that no one measure had extreme skewness or kurtosis. Cronbach alphas were obtained as one measure of reliability. For the FTP subscales of connectedness, distance and speed they were .74, .70, and .77, respectively. These are all in the acceptable range. Alphas for the PI subscales of endogenous and exogenous instrumentality were both .91, and knowledge building, .94, both excellent. The alphas on the three FTP subscales, endogenous instrumentality and knowledge building were within range of previously reported alphas, but the alpha for the revised exogenous instrumentality subscale was significantly higher than a previous report of .64, which is questionable. (Hilpert et al, 2012).

Table 2
Study 1 Descriptive Statistics for Study Variables.

Variables	Min	Max	*M*	*SD*	Skew	Kurtosis
Endogenous Instrumentality	1.00	5.00	3.81	1.01	-0.98	0.47
Exogenous Instrumentality (revised)	1.00	5.00	2.57	1.08	0.74	-0.81
FTP Connectedness	2.67	5.00	4.26	0.55	-0.68	0.04
FTP Speed	1.00	5.00	3.14	0.90	-0.19	-0.61
FTP Distance	1.00	5.00	3.09	0.76	-0.20	-0.38
Knowledge Building	1.00	5.00	3.58	0.83	-0.96	1.15

A correlation matrix was obtained and is provided in Table 3. These statistics supported the increased measurement ability of the revised exogenous instrumentality subscale. Correlations with related measures of connectedness and knowledge building were greatly improved upon from previous reports (Hilpert et al, 2012). Exogenous instrumentality is significantly negatively correlated with reported use of knowledge building strategies, as

predicted. All correlations were significant at the <.001 level with the exception for four, which were both low and not significant. Those are exogenous instrumentality and speed (.10), endogenous instrumentality and speed, distance and connectedness (.10), and knowledge building and speed (-.03).

Table 3

Study 1 Correlations Among All Study Variables.

Variables	1.	2.	3.	4.	5.	6.
1. Endogenous Instrumentality	1					
2. Exogenous Instrumentality (revised)	-.65**	1				
3. FTP Connectedness	.39**	-.26**	1			
4. FTP Speed	.05	.10	-.18**	1		
5. FTP Distance	.23**	-.19**	.10	-.24**	1	
6. Knowledge Building	.77**	-.60**	.46**	-.03	.22**	1

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Factor Analysis. The dimensionality of the 8 items that make up the perceptions of instrumentality scale was analyzed using maximum likelihood factor analysis. Several criteria were used to determine the number of factors to rotate. The first was a combination of the literature and an apriori hypothesis. A scree plot, eigen values, and the interpretability of results were also used. Consistent with our hypothesis, the data indicated that 2 factors should be rotated. These two factors, endogenous and exogenous instrumentality share a high amount of variance. Because of this, an oblimin rotation was used. The rotated factor solution, as shown in Table 4, yielded two interpretable factors, endogenous instrumentality and exogenous instrumentality. The endogenous factor accounted for 59.3% of the item variance and the exogenous factor accounted for 11.4% of the item variance. No items loaded strongly on both factors.

Table 4

Study 1 Correlations between the perceptions of instrumentality scale items and the endogenous and exogenous instrumentality factors.

Items	Factors	
	Endogenous	Exogenous
Endogenous Instrumentality Items		
What I learn in {insert course name} this year will be important for my success at my future job.	**.72**	-.13
What I gain from {insert course name} will shape my future.	**.90**	.02
I will use the information I learn in {insert course name} in the future.	**.87**	.03
I will use the information I learn in {insert course name} when I take other classes in the future.	**.83**	.00
Exogenous Instrumentality Items (revised)		
The only aspect of {insert course name} that will affect my academic future is my grade.	-.02	**.84**
The only thing useful to me in {insert course name} is the grade I get.	-.15	**.73**
The only aspect of this class that will matter after graduation is my grade.	.11	**.98**
To reach my academic goals, all I need from this course is my grade.	-.04	**.75**

Two regression analyses were conducted to evaluate the additive value of the exogenous instrumentality variable in predicting knowledge building skills. That is, does exogenous instrumentality explain or account for more variance in the knowledge building variable above and beyond what the endogenous variable already provides? The results of the first analysis indicate that as Endogenous PI increases, so does reported use of knowledge building strategies. R^2 =.59, adjusted R^2 =.59, $F(1,219)=320.53$, $p<.000$. A multiple regression analysis was conducted to determine if there was any evidence of exogenous scale improving the predictive validity of knowledge building above and beyond endogenous instrumentality. The results indicated that a linear combination of the PI measures are significantly related to the knowledge building measure, R^2 =.61, adjusted R^2 =.61, $F(2,218) = 8.77$, $p<.01$.

The sample correlation coefficient was .77 indicating that approximately 60% of the variance of the knowledge building variable is accounted for by the linear combination of endogenous and exogenous instrumentality. This indicates that the variables are linearly related

such that as endogenous instrumentality increases and exogenous instrumentality decreases, reported knowledge building strategies increase. The regression equation for predicting knowledge building is

Knowledge Building = .538 EndoPI -.126 ExoPI + 1.86

The 95% confidence interval for the slope for EndoPI, .45 to .63, and for ExoPI, -.21 to -.04 do not contain the value of zero, and therefore the two variables are significantly related to the knowledge building variable. As hypothesized, the exogenous variable does add to the predictive value of the instrumentality scale in predicting knowledge building. The endogenous and exogenous subscales do share collinearity (Tolerance =.58, VIF=1.74). Each subscale measures a portion of an overarching construct, Perceptions of Instrumentality and because of the high degree of collinearity of the subscales, it is no surprise that while the results of the regression analysis are significant, the additive value of the exogenous construct in this equation is small (ΔR^2=.016).

Discussion

The data analysis supported our two hypotheses, the first of which was that the revised exogenous subscale when combined with the endogenous subscale would factor out in to two distinct factors. The items loaded well on 2 distinct factors when an oblique rotation was used. The second hypothesis was also supported with the results of the regression analysis. The revised exogenous subscale adds to the predictive validity of the overarching instrumentality scale. The exogenous sub-scale's contribution was small, but still statistically significant. Because the constructs of exogenous and endogenous instrumentality are related and share a high amount of variance, this was not surprising. Had we entered exogenous instrumentality variable in to the analysis first it would likely have accounted for the majority of the variance in the equation.

Revisiting the correlation table, there are some interesting relationships to note. As anticipated, the revised exogenous instrumentality subscale was negatively correlated with knowledge building. When an individual endorses a performance goal or extrinsic goal orientation towards a course research shows that they also report a decreased use of knowledge building

strategies (Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Students that self-reported or endorsed exogenous instrumentality for the content they were learning in the course they reported on were less likely to report high endogenous value of content for the same course, as well as use of knowledge building strategies. The correlation between the exogenous subscale and the endogenous subscale is interesting though in that it is negative. Assuming that we are attempting to measure different pieces of some overarching construct (instrumentality), they should theoretically be positively correlated, but in this study they are not. This is something that will be further investigated in study two, where we will have the original exogenous subscale to compare it against.

Connectedness to or planning for the future was positively correlated with endogenous instrumentality and reported use of knowledge building strategies. The revised exogenous instrumentality subscale was negatively correlated to connectedness. As one thinks about and plans for the future, reported exogenous instrumentality of content decreases.

CHAPTER 5

STUDY 2

Introduction. Study one allowed us to look at the reliability and validity evidence for the revised subscale. Study 2 allowed us to determine if any improvement was made over the original version of the exogenous instrumentality scale and allowed for evaluation of both versions of the exogenous subscales together. Having the same participants complete both scales at the same point in time allowed for a more appropriate measure of scale improvement. It allowed for comparison of reliability and validity evidence for both versions of the subscale from the same sample as well as exploring factor analysis and modeling.

Research Questions

The research question for study 2 is as follows:

1. How do the relationships (correlations) with the revised subscale compare to the relationships (correlations) with the original subscale?
2. Does the revised exogenous PI scale have stronger reliability and predictive validity evidence than the original scale?
3. Do the relationships between future time perspective variables, instrumentality and knowledge building change when the revised subscale is used in the Pathways to Knowledge Building model (Hilpert, et al, 2012).

Methods

Participants. After receiving IRB approval, instructors from identified courses were emailed and asked if they would be willing to allow a researcher into their classroom to recruit students for a study. Participants were recruited from introductory courses in human development, sociology and geology. Instructors invited the researcher in to recruit in person and posted an announcement with a link to the survey in their online course management site. Students were also recruited from these same courses that are taught entirely online. A total of 487 students participated in the survey. 44 of these participants started the survey and did not complete it. Another 2 participants selected “prefer not to answer” to every item. Another 31

participants selected “prefer not to answer to one or more survey items. All 77 of these cases were removed prior to data analysis, leaving 410 participants. 53 students reported on their human development course, 295 on their intro to sociology course, and 62 on their geology course. 244 participants were female (59.5%), 163 were male (39.8%) and 3 (.7%) selected “I prefer not to answer this question”. Only 19 students reported that they were also majoring in the same field as the course that they were reporting on.

Procedure. After consenting to participate, participants completed a survey consisting of 42 questions on an online data collection website**.** Participants were entered in to a raffle to win one of 10-$25 gift cards to Amazon.com that were distributed to 10 students at random (using random.org) via email after data collection was complete. This method of recruitment was previously used for other data collections and proved to be efficient for both participants and researchers. Those that won were emailed their gift card code. No in person contact after completion of the survey was necessary. Email addresses were immediately separated from data and placed in a separate list that was used for distribution of incentives and then deleted. Data was cleaned, coded, reverse scored where necessary, and entered into SPSS. All data were encrypted and password protected and stored in cloud storage.

Measures. The same measures utilized in study 1 will also be used in study 2. If needed, additional changes will be made to the exogenous PI subscale. A 5 point Likert scale with a 6 option of “I prefer not to answer” was used for each item. All items were forced answer, meaning that they could not proceed to the next page until a response had been provided for all items on the current page. The original exogenous subscale was also deployed, as discussed previously, so that change/improvement of the scale can be measured within the same sample. Except for demographic questions, all survey items were presented in random order (within and across scales) for each person so as to minimize order effects or fatigue.

Plan of Analysis

All items loaded well on to the same factor in Study 1 so no additional rewording was required. Given this, I proceeded directly to Confirmatory Factor Analysis. Correlation matrices

were also consulted to aid in answering research questions 1 and 2. Structural Equation Modeling will be utilized to explore the paths between the constructs at hand. The literature indicates that the PI subscales are proximal measures of future orientation and should have strong paths with measures of connectedness, but not speed and distance (all measures from the FTPS). For this reason, constraining the relationships with the ExoPI and EndoPI variables with the Speed and Distance variables would be appropriate. Assuming that the ability to measure this construct has improved with scale revision, an increased correlation (perhaps negative) with the outcome variable knowledge building, as well as the distal measure of FTP- connectedness should be observed.

Results

The data were cleaned and coded and items that were negatively worded were reverse coded. Cases with missing data were removed from the analyses. “I prefer not to answer” responses were recoded as “0” and removed prior to analysis. Descriptive statistics, provided in Table 5, indicate that the variables were similarly distributed as in study 1 and deviated slightly from measures of central tendency. Cronbach alphas were obtained as one measure of reliability. For the FTP subscales of connectedness, distance and speed were acceptable (alpha = .71, .74, and .74, respectively). Alphas for the PI subscales of endogenous subscale was good (alpha =.87), the original exogenous scale was questionable (alpha= .60), the revised exogenous subscale and knowledge building, were good (alpha= .87, .89 respectively). The alphas for all subscales were within range of those found in study 1, as well as previous reports from other studies (Hilpert et al, 2012).

Table 5

Study 2 Descriptive Statistics for Study Variables.

Variables	Min	Max	*M*	*SD*	Skew	Kurtosis
Endogenous Instrumentality	1.00	5.00	3.57	.86	-.63	.37
Exogenous Instrumentality (original)	1.50	5.00	3.70	.67	-.41	.19
Exogenous Instrumentality (revised)	1.00	5.00	2.79	.97	.28	-.67
FTP Connectedness	1.00	5.00	4.14	.52	-.93	3.21
FTP Speed	1.00	5.00	3.27	.88	-.03	-.67
FTP Distance	1.00	5.00	2.87	.72	.16	-.43
Knowledge Building	1.00	5.00	3.51	.69	-.61	1.19

As noted above, the participants were distributed very unevenly across the three courses sampled. Additionally, it has been noted in prior research that because some of the items and scales used are course specific, students are able to discriminate between the value they place on different content and courses (Tabachnick, Miller, & Relyea, 2008; Hilpert, et al., 2012; Shell & Soh, 2013). For these two reasons, analyses of variance were explored. To determine if there were course level differences in the responses to the measures included in this study a one-way analysis of variance was conducted. The independent variable, course, included three levels, human development, sociology and geology (the three courses sampled in this study). The dependent variables were endogenous instrumentality, exogenous instrumentality, speed, distance, connectedness and knowledge building. Given the skew and kurtosis information provided in table 5, it was assumed that assumptions of normal distribution and equal variances had been violated and so the Browne-Forsythe statistic was obtained for each variable. All analyses were significant except for the distance variable, as noted in table 6. An interesting finding of note here is that there were significant differences on the connectedness variable between the students that reported on their human development course and those that reported on their geology and sociology courses (See Table 7). Perhaps this is because students are more easily able to relate the content of this course to their lives than they are sociology or geology?

Table 6

Analysis of Variance for all study variables. Equal variances not assumed.

Variable	*df*	F	η^2	Sig.
Endogenous PI	142.2	65.05	.07	.00
Exogenous PI	145.61	6.89	.00	.00
Exogenous PI (revised)	165.99	46.07	.02	.00
FTP Connectedness	169.10	8.53	.00	.00
FTP Speed	156.66	3.28	.00	.04
FTP Distance	158.39	.22	.00	.80
Knowledge Building	130.86	19.74	.01	.00

Note: Brown-Forsythe test for equality of means was used.

Table 7

One way ANOVA Interactions for Course as Independent Variable

Dependent Variable	Course 1=Human Dev., 2= Sociology, 3=Geology		Mean Difference (I-J)	Std. Error	Sig.	95% CI Lower Bound	95% CI Upper Bound
Endogenous Instrumentality	1	2	.55*	.11	.00	.29	.82
		3	1.59*	.14	.00	1.25	1.92
	2	1	-.55*	.11	.00	-.82	-.29
		3	1.03*	.10	.00	.78	1.28
	3	1	-1.59*	.14	.00	-1.92	-1.25
		2	-1.03*	.10	.00	-1.28	-.78
Exogenous Instrumentality (Original)	1	2	.36*	.10	.00	.13	.60
		3	.27	.12	.09	-.03	.57
	2	1	-.36*	.10	.00	-.60	-.13
		3	-.09	.09	.96	-.31	.13
	3	1	-.27	.12	.09	-.57	.03
		2	.09	.09	.96	-.13	.31
Exogenous Instrumentality (Revised)	1	2	-.79*	.13	.00	-1.11	-.47
		3	-1.43*	.17	.00	-1.83	-1.03
	2	1	.79*	.13	.00	.47	1.10
		3	-.65*	.12	.00	-.95	-.35
	3	1	1.43*	.17	.00	1.03	1.83
		2	.65*	.12	.00	.35	.95
Connectedness	1	2	.27*	.08	.00	.09	.45
		3	.29*	.09	.01	.06	.52
	2	1	-.27*	.08	.00	-.45	-.09
		3	.02	.07	1.00	-.15	.19
	3	1	-.29*	.09	.01	-.52	-.06
		2	-.02	.07	1.00	-.19	.15
Speed	1	2	-.31*	.13	.05	-.63	-.00
		3	-.32	.16	.16	-.71	.07
	2	1	.31*	.13	.05	.00	.63
		3	-.00	.12	1.00	-.30	.29
	3	1	.32	.16	.15	-.07	.71
		2	.00	.12	1.00	-.29	.30
Distance	1	2	.06	.11	1.00	-.19	.32
		3	.03	.13	1.00	-.29	.35
	2	1	-.06	.11	1.00	-.32	.19
		3	-.03	.10	1.00	-.27	.21
	3	1	-.03	.13	1.00	-.35	.29
		2	.03	.10	1.00	-.21	.27
Knowledge Building	1	2	.27*	.10	.02	.03	.50
		3	.77*	.12	.00	.47	1.06
	2	1	-.27*	.10	.02	-.50	-.03
		3	.50*	.09	.00	.28	.72
	3	1	-.77*	.12	.00	-1.06	-.47
		2	-.50*	.09	.00	-.72	-.28

* Mean difference is significant at the .05 level

Table 8

Study 2 Correlations Among All Study Variables.

Variables	1.	2.	3.	4.	5.	6.	7.
1. Endogenous Instrumentality	1						
2. Exogenous Instrumentality	(.20**)/.35* .20**/.13	1					
3. Exogenous Instrumentality (revised)	(-.63**)/-.47** -.55**-.65**	(-.17**)/-.38** -.13*/-.05	1				
4. FTP Connectedness	(.33**)/.37** .36**/.18	(.20**)/.30* .16**/.20	(-.19**)/-.12 -.17**/-.01	1			
5. FTP Speed	(-.04)/-.25 -.01/.19	(.02)/.02 .07/-.04	(.17**)/.06 .17**/.07	(-.15**)/-.21 -.12*/-.12	1		
6. FTP Distance	(.02)/.01 .06/-.14	(-.04)/-.03 -.06/-.01	(-.06)/-.16 -.05/-.10	(.14**)/.09 .17**/-.04	(-.25**)/-.32* -.23**/-.27*	1	
7. Knowledge Building	(.61**)/.61** .49**/.71**	(.21**)/.28* .21**/.15	(-.49**)/-.30* -.42**/-.54**	(.31**)/.37** .32**/.17	(-.09)/-.12 -.11/.09	(.17**)/.15 .24**-.03	1

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
Full data set in parenthesis, followed by course level correlations. (Human Development, Sociology and then Geology)

To answer the first question in this study, (Does the revised exogenous PI scale correlate better with other related measures than the original exogenous PI scale?) a correlation matrix was obtained and is provided in Table 8. For the entire sample as well as by course. Some of these statistics supported the increased measurement ability of the revised exogenous instrumentality subscale. Correlations with related measures of PI and knowledge building were greatly improved upon from the original scale, shown in the table, as well as previous reports (Hilpert et al, 2012). Exogenous instrumentality is significantly negatively correlated with reported use of knowledge building strategies, as predicted and found in study 1. All correlations were significant at the <.001 level with the exception for six, all of which were both low and not significant. Those are; the original exogenous instrumentality subscale with speed (.02), and distance (-.04); the endogenous instrumentality subscale with speed (-.04) and distance (.02); and the revised exogenous instrumentality subscale with distance (-.06). The sixth non-significant correlation was between knowledge building and speed (-.09). The revised exogenous instrumentality subscale again correlated very strongly in a negative manner with the endogenous subscale, as seen in Study 1. This is the opposite relationship we would expect theoretically. This will be explored further in additional analyses not discussed in the initial plan of analysis.

To answer the second question in this study (Does the revised exogenous PI scale have better reliability and validity evidence than the original scale?) we started with factor analyses. Two factor analyses were run to determine if the revised EndoPI subscale supports a 2-factor structure better than the original subscale. A factor analysis with an oblique rotation was used for both. The rotated factor solutions, as shown in Tables 9 and 10, both yielded two interpretable factors, endogenous instrumentality and exogenous instrumentality, but the revised subscale loads much better onto the second factor than the original subscale as shown in Table 10.

Table 9

Study 2 Factor Analysis of Endogenous Instrumentality and the Original Version of the Exogenous Instrumentality Subscales

Items	Factors	
	Endogenous	Exogenous
Endogenous Instrumentality Items		
What I learn in {insert course name} this year will be important for my success at my future job.	**.84**	-.02
What I gain from {insert course name} will shape my future.	**.78**	.09
I will use the information I learn in {insert course name} in the future.	**.82**	.04
I will use the information I learn in {insert course name} when I take other classes in the future.	**.72**	-.07
Exogenous Instrumentality Items		
I must pass this class in order to reach my academic goals.	.04	**.53**
The grade I get in this class will affect my future.	.01	**.67**
The grade I get in this class will not affect my ability to continue on with my education	-.05	**.51**
What grade I get in this class will not be important for my future academic success.	.01	**.42**

The first analysis included the original subscales. The endogenous factor accounted for 33.5% of the item variance and the exogenous factor accounted for an addition 12.92% of the variance. No items loaded on both factors. The Chi-square goodness of fit test was not significant (X^2=18.45, p=.14). The second analysis included the revised ExoPI subscale. In this analysis, the endogenous subscale accounted for 54.79% of the variance and the revised exogenous subscale accounted for 9.03% of the variance. The Chi-square goodness of fit test was significant (X^2=49.64, p<.000). These results, along with the unexplainable negative correlation between the endogenous and revised exogenous subscales led to one additional factor analysis with both versions of the exogenous subscales and the endogenous subscale, shown in Table 11.

Table 10

Study 2 Factor Analysis of Endogenous Instrumentality and the Revised Version of the Exogenous Instrumentality Subscales

	Factors	
Items	Endogenous	Exogenous
Endogenous Instrumentality Items		
What I learn in {insert course name} this year will be important for my success at my future job.	**.82**	-.02
What I gain from {insert course name} will shape my future.	**.70**	-.16
I will use the information I learn in {insert course name} in the future.	**.75**	-.12
I will use the information I learn in {insert course name} when I take other classes in the future.	**.77**	.11
Exogenous Instrumentality Items (revised)		
The only aspect of {insert course name} that will affect my academic future is my grade.	.04	**.81**
The only thing useful to me in {insert course name} is the grade I get.	-.01	**.83**
The only aspect of this class that will matter after graduation is my grade.	-.06	**.78**
To reach my academic goals, all I need from this course is my grade.	-.03	**.73**

Table 11

Study 2 Factor Analysis of Endogenous Instrumentality and both original and revised versions of the Exogenous Instrumentality Subscales

Items	Factors		
	Endogenous	Exogenous	Third Factor
Endogenous Instrumentality Items			
What I learn in {insert course name} this year will be important for my success at my future job.	**.77**	.01	.11
What I gain from {insert course name} will shape my future.	**.66**	.12	.21
I will use the information I learn in {insert course name} in the future.	**.71**	.07	.18
I will use the information I learn in {insert course name} when I take other classes in the future.	**.73**	-.05	-.01
Exogenous Instrumentality Items			
I must pass this class in order to reach my academic goals.	.11	**.52**	-.07
The grade I get in this class will affect my future.	.15	**.69**	-.19
The grade I get in this class will not affect my ability to continue on with my education	-.08	**.50**	.06
What grade I get in this class will not be important for my future academic success.	-.10	**.41**	.18
Exogenous Instrumentality Items (revised)			
The only aspect of {insert course name} that will affect my academic future is my grade.	-.06	.03	**-.75**
The only thing useful to me in {insert course name} is the grade I get.	-.09	-.05	**-.77**
The only aspect of this class that will matter after graduation is my grade.	-.12	-.02	**-.75**
To reach my academic goals, all I need from this course is my grade.	-.11	.04	**-.69**

The results of this third and final factor analysis indicate that instead of improving on a measure of exogenous instrumentality, the revised subscale may be measuring something entirely different. While the result of the Chi-square goodness of fit test was significant (X^2=72.12, p<.000), each subscale loads very distinctly on to three separate factors. The endogenous subscale accounts for 37.48% of the variance, the original exogenous subscale, 7.75%, and the revised exogenous subscale and additional 7.84% of the variance for a total of 53% of the variance explained in reported use of knowledge building strategies. If we had improved on the original subscale, the items should load on the same factor, even if not strongly,

but they don't. It appears as if what we have created is a scale that measures another construct. This was taken into consideration during the next step of data analysis, regression analysis.

This third variable that we have unintentionally measured still appears to have some future orientation aspect to it and whether it plays a role in predicting our outcome variable is still of interest, so another regression analysis was run, regressing knowledge building on endogenous instrumentality, exogenous instrumentality and then our third variable. The results indicated that a linear combination of all three measures is significantly related to the knowledge building measure, R^2 =.40, adjusted R^2 =.39, $F(1,406) = 11.86$, $p<.001$.
The variables are linearly related such that as endogenous instrumentality and exogenous instrumentality increases and our third variable decreases, reported knowledge building strategies increase. The regression equation for predicting knowledge building is

Knowledge Building = .388 EndoPI +.085 ExoPI -.122 third variable + 2.157

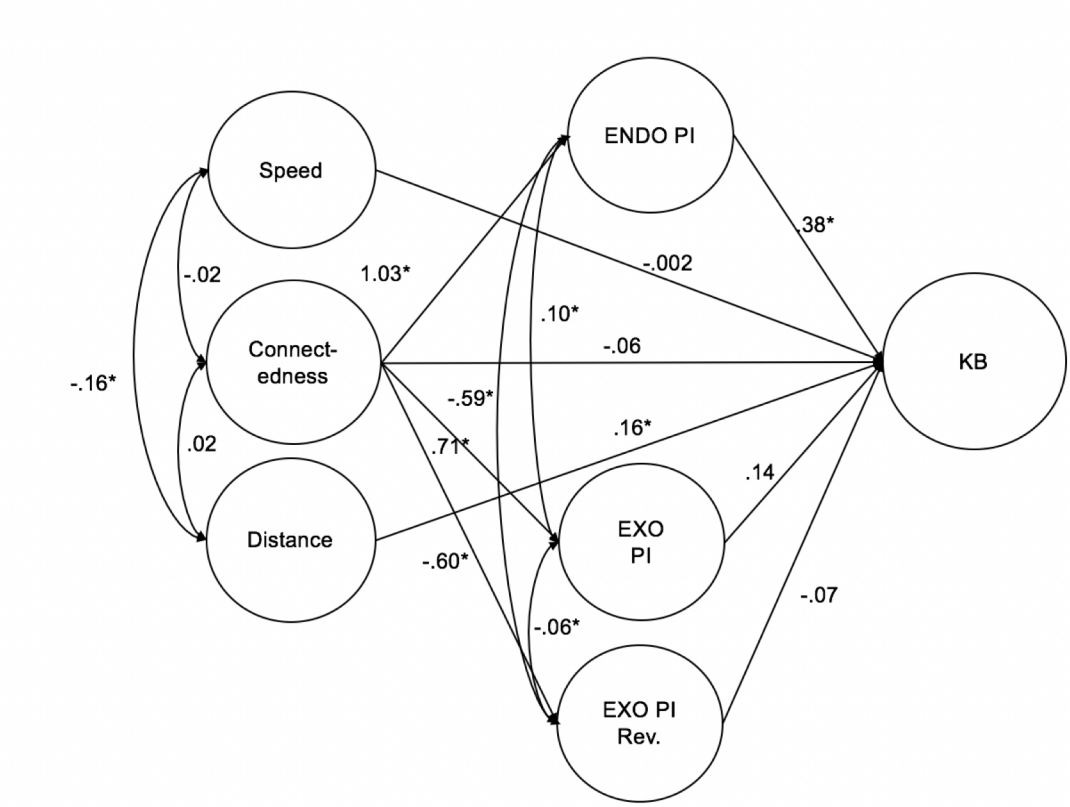
The 95% confidence interval for the slope for EndoPI, .31 to .47, for ExoPI, .01 to .16 and for our third variable -.19 to -.05. None of these confidence intervals contain the value of zero. The subscales do share collinearity (Tolerance =.60, VIF=1.66). Not so surprisingly, and consistent with prior research the new scale is different, yet still overlaps with endogenous instrumentality and so the additive value of the exogenous construct and the third variable is small (ΔR2=.018).

Next, an attempt to reproduce the model of global, local and domain specific measures of Future Time Perspective specified by Hilpert et al, (2012). The original plan was to attempt to better represent the exogenous instrumentality construct and how it relates to knowledge building with the scale revisions, but because our revised scale is measuring something different, I have instead added it in to the model. This new measure has strong relationships with several of the other measures in the correlation table, and it was additive in the regression analysis, so this seemed like the appropriate way to look at the measures together. The relationships between

speed, distance and the instrumentality variables were constrained as we were trying to replicate Hilpert et al's (2012) model and that is how they specified it.

Figure 2

Pathways to knowledge building model with original and revised exogenous scales.



Note: * indicates that relationship is significant at P<.05 level.

Table 12

Goodness-of-fit Indices for global, local and domain specific measures of future time perspective for the Pathways to Knowledge Building Model.

Model	X^2	*df*	CFI	TLI	SRMR	RMSEA (90% CI)	AIC
Model 2	1169.51*	512	.88	.87	.08	.052 (.05-.06)	33524.5

Note. CFI = Comparative Fit Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; 90% CI = Confidence Interval for RMSEA; TLI = Tucker-Lewis Index; AIC = Akaike Information Criterion, * indicates p<.01; Model's 1 and 3 had errors and goodness of fit indicies were not generated.

Discussion

RQ1. How do the relationships (correlations) with the revised subscale compare to the relationships (correlations) with the original subscale? The results indicated that the revised exogenous scale has stronger correlations with knowledge building, endogenous instrumentality, and speed. While the correlation with knowledge building was negative, as predicted, so was the correlation with endogenous instrumentality. This is cause for concern, as it is not consistent with the theory within which the scale is situated. Additional analyses of correlations by course indicated that while the general trend of the correlations was consistent across courses, there were significant differences between courses on the majority of the variables.

RQ2. Does the revised exogenous PI scale have stronger reliability and predictive validity evidence than the original scale? The revised exogenous subscale does have increased reliability evidence, but not validity evidence. While the reported alphas for the new subscale were much more desirable than those of the original subscale, as well as the factor loadings in the 2 factor CFA, the negative correlation with the endogenous scale is not consistent with the scale's theoretical underpinnings. Subsequent factor analysis run with the endogenous, original exogenous and revised exogenous subscales that resulted in a distinct 3 factor model was additional evidence against the validity of the revised scale. One of our measures is not measuring what it theoretically should.

RQ3. Do the relationships between future time perspective variables, instrumentality and knowledge building change when the revised subscale is used in the Pathways to Knowledge Building model.

The revised scale is measuring a different factor or construct, so the model specified in this study included both the original and revised measures of exogenous instrumentality. The fit indicies are not optimal so the following interpretations are made with caution. Endogenous and exogenous instrumentality are positively related to knowledge building and the revised scale is negatively related to knowledge building. The relationship between enodgenous and exogenous subscales is very weak but positive and significant, and the relationship between the origianal and revised exogenous subscales is strong, negative and significant. Endogenous Instrumentality mediates the relationship between connectedness and knowledge building. Connectedness has a strong, significant, negative path with the revised subscale, and a strong, significant positive path with the original subscale. These data provide insight into the dynamic way that future time orientation can change across courses and the additive value that the new subscale provides.

Connectedness shouldn't be different based on class but in this study it is. The way the scale was presented it did have a career specific orientation to it and that keyed into the specificity of the content for their future careers, (e.g., "I should take steps today to help realize future goals for {insert field} related jobs.") Perhaps students in certain courses (e.g., intro to geology) value the content for their future so little that the rating on that one item brought their scale score down significantly? Or, perhaps the students surveyed in this course are just different than previously studied populations. All courses surveyed were entry level courses and students were likely early in their academic careers. Perhaps this also contributed to the differences measured in this study. In hindsight it is useful to note that only 19 of the 420 participants in this study were majoring in the fields for which they reported on. In this instance maybe the global measure of connectedness that did not have a career specific item in it would have better measured connectedness in this study.

Chapter 6

General Discussion

As instructors, we know from the literature that it is important to convey the value of the content to our students, but we also need to be mindful that the type of value that we endorse can have a variable impact on the ways in which students engage in the content. A student's choice to engage in knowledge building strategies in a course is largely dependent on how they value the content that they are learning (Shell, et al., 2005). High value for the content and its usefulness for the future (endogenous instrumentality) can result in the use of knowledge building strategies, and value for the content only for achieving a goal and not for the usefulness of the content itself (exogenous instrumentality) can result in in lack of use of knowledge building strategies (Shell D. F., Soh, Flanigan, & Peteranetz, 2016). Exogenous instrumentality should theooretically be important but previous studies have not demonstrated high correlations with variables that it should be related to. While a good measure for endogenous instrumentality exists (Husman, Derryberry, Crowson, & Lomax, 2004; Hilpert, et al., 2012; Shell D. F., Soh, Flanigan, & Peteranetz, 2016), the aim of this study was to validate and improved measure of exogenous instrumentality.

The results of these two studies are inconsistent with our expectations and indicate that instead of improving a scale we instead created a new scale measuring a separate and distinct construct. It does appear to be measuring some sort of extrinsic future oriented motivation (e.g. "The only thing useful to me in {insert course name} is the grade I get"), but it is not exogenous instrumentality (e.g. "The grade I get in this class will affect my future"). If it were exogenous instrumentality it would be positively correlated, at least in theory (Husman & Lens, 1999), with the connectedness subscale, and the correlation matricies for both studies conducted indicate that it is not. The new subscale touches highly on extrinsic instrumentality for grade which provides several avenues for further research.

While it was anticipated that the revised scale would have stronger relationships with variables like connectedness and endogenous instrumentality, it was not anticipated that they

would be negative. This was the first indication that we may not be measuring what we had planned to measure. The second indication was the very clean factor analysis. The results of the factor analysis with the endogenous, exogenous and revised scale items shows 3 very distinct factors when they are all analyzed together. The factor analysis, combined with the unexpected correlations lend themselves to an interesting conversation about theoretical implications of the results.

Husman and Lens (1999) identified 3 types of instrumentality; endogenous, exogenous and extrinsic instrumentality. Where endogenous instrumentality is the value of the content for a future goal and exogenous instrumentality is the value of the outcome of the task for a future goal, both of these types of instrumentality may enhance motivation and can occur together or individually. It is the third type of instrumentality, extrinsic instrumentality that undermines motivation and is externally regulated. I believe that this third type of instrumentality is what we have measured here. The original exogenous subscale allowed individuals to endorse both endogenous and exogenous instrumentality, consistent with the theory. When we revised the exogenous subscale we unintentionally made the items dichotomous with the endogenous scale. You could endorse one or the other, but not both. Both of these studies have demonstrated that students that endorse an extrinsic instrumentality for grade report decreased use of knowledge building strategies.

Theoretical Implications

Future Time Perspective. The results of this study provide additional evidence that not only do students make judgments about the ways in which the content of a course is valuable, they do so very early on in the course (week 4 of 16 in the courses for these studies), and these judgements impact the way they engage in and learn the content. While previous research with the original exogenous instrumentality subscale showed only small positive correlations between value for course (grade) outcome and knowledge building skills (Hilpert, et al., 2012), the revised scale measured a large negative correlation between these two variables with one new caveat, when the grade is the *only* thing the student is focused on. The previous exogenous subscale

was worded in such a way that it allowed students to endorse both endogenous and exogenous instrumentality simultaneously. By this I mean that students were able to indicate that they both valued the content for their future goals *and* the outcome of the course (i,e., their grade). The scales allow for them to endorse both endogenous and exogenous instrumentality for what they were learning in a given course.

With the revised exogenous subscale, this was no longer the case. By endorsing the revised scale items the students were forced to endorse only the value for the outcome of the course, not for the content. It is almost as if the revised wording captured some sort of closed contingent future oriented pathway as described by Raynor and Rubin (1971). Because this type of value creates a contingent pathway in which a student must succeed on one task in order to move on to the next it almost appears as if this orientation constrains students' ability to think about and connect the content with their future on a broader level. One might also argue the reverse ordering is true, that the student's ability to think about and connect with their future is constrained, hence they end up on a closed contingent path, unable to see the endogenous value of the content. This is consistent with previous research. Lens and Moreas (1994) demonstrated that an individual's connectedness to their future, distal goals had a positive effect on perceived instrumentality. Students with stronger connectedness to distant goals reported study behaviors that were significantly higher than for those with a short FTP. This research was done prior to instrumentality being broken out in to endogenous and exogenous, but the article appears to indicate that what they are calling instrumentality we now refer to as endogenous instrumentality. The content of the task, not the outcome of the task, was the focus of the study.

An additional implication for Future Time Perspective work, was the finding (or lack there of) that there was only a small weak relationship between distance and all of the instrumentality scales. There are two explanations for the lack of relationships demonstrated in this study. One is that distance simply isn't related to instrumentality. The second explanation may be that the way that distance is measured it isn't extended far enough. The Future Time Perspective Scale (Husman & Shell, 2008) currently does not take into account meaningful amounts of time that one sets goals for, especially in regards to how these goals relate to the instrumentality of the content

they are learning. Distance should be more strongly correlated with measures of instrumentality, but that was not evident in this study. Most of the items used to measure distance all measure about 6 months out, (e.g., “In general, six months seem like a very short period of time”), more than a semester but less than the amount of time it takes to get a college degree only one asks about a semester (e.g., “It often seems like the semester will never end”). Being able to better measure a person’s projection of distance in to the future may lead to further explanation into the reported differences we see in these three types of value measured in this study. It may also have important implications for the newly emerging study of motivational profiles (Shell & Soh, 2013; Shell D. F., Soh, Flanigan, & Peteranetz, 2016). Further work needs to be done to tease out these relationships.

Expectancy Value Theory. The findings of these studies also have implications for the current state of Expectancy Value theory and more specifically our understanding of what utility value is. As currently defined by Eccles and Wigfiled (1995) utility value is “the value a task acquires because itis instrumental in reaching a variety of long- and short-range goals” (p.216). as defined, utility value does not differentiate between types of goals or whether those goals are proximal or distal. Using an FTP and Expectancy Value framework Husman and Lens (1999) identified different types of utility value (endogenous and exogenous instrumentality) which can both be said to be related to the long range goals referred to by Eccles and Wigfield (1995) in the definition of utility value, and were the subject of the studies here. Husman and Lens (1999) hypothesized that there was a third type of instrumentality but did not investigate further. In this study we created a scale that appears to measure this third type of instrumentality. I would hypothesize that this newly created third scale that measures extrinsic instrumentality for grade is a third type of utility value, but perhaps with a shorter future time orientation that endogenous and exogenous instrumentality, similar to the externally controlled proximal instrumentality that Simons, Dewitte, & Lens (2004) identified and the short-range goals that Eccles and Wigfield (1995) referred to. Because each of these measures were shown to have very different relationships with local measures of FTP as well as with knowledge building it is important to parse them out in future research. Distinguishing between these types of instrumentality which

are often all lumped together as utility value in work done by expectancy value theorists can be important not only for measurement purposes, but for determining the efficacy of interventions, such as those conducted by Hulleman and colleagues (2010, 2016). While I did not include the expectancy value measure in my study, it is an important next step to create more clairty in the measures and consistencey within the field. This will help Expectancy Value theorists to converge upon both definitions and measures for these constructs.

Educational and Practical Implications

While the revised scale did not take us where we had anticipated, the information derived from these studies still has important implications for education. It provides us with a model for what student's choice of learning strategies looks like when they endorse endogenous instrumentality, exogenous instrumentality, or extrinsic value for grade. These data further confirm results from previous studies that having a performance or outcome orientation and not endorsing value for the content one is learning results in poor use of optimal knowledge building strategies. This means that teachers need to pay careful attention to not only the way that they endorse different types of value for their students, but also how their students assign value to the content of courses. Utilizing strategies that increase students' endogenous instrumentality for the content at hand may decrease this orientation towards utility value for grade. Ways of increasing endogenous instrumentality have been provided by Puruhito, Husman, Hilpert, et. al, (2011), Harackiewicz, Canning, Tibbetts, et. al, (2015) and Hulleman, Kosovich, Barron, & Daniel (2016).

Future Directions

While this study provided for evidence for the reliability of the revised subscale, analyses revealed that it is not a valid measure of the construct we were attempting to measure. The information obtained is still useful, but it leaves us with a variety of next steps. First, back to the lab to attempt to improve the measure of exogenous instrumentality. It is important to be able to distinguish this type of instrumentality from both endogenous and extrinsic instrumentality for grade, so additional work on improving this scale is necessary. Second, it is important to look at how extrinsic instrumentality is related to other outcome variables like use of other learning

strategies, final course grade, self-regulation and motivation. Shell and Soh ((2013) identified two different pofiles/types of students that are successful. One is a student that is intrinsically/endogenously motivated by the content. The other is students that are extrinsically motivated. Both of these students use different types of learning strategies. It would be interesting to explore the dynamic ways in which extrinsic instrumentality is related to these learning profiles Shell and Soh (2013) have identified.

Concluding Remarks

Currently, the research seems to lack a good measure of exogenous instrumentality. The present study attempted to provide a revised measure of exogenous instrumentality, but instead create a measure of extrinsic instrumentality for grade which has a different relationship with connectedness to the future and use of knowledge building strategies than the original scale. Further research is needed to explain the relationships observed between some of the constructs in this study with this new measure, as well as continued revision of the exogenous subscale. Nonetheless, the results were informative. It is clear from these studies that students that lack endogenous instrumentality for the content they are learning are less likely to endorse optimal knowledge building strategies for learning the content and have a shorter future time orientation or connectedness to the future. Because use of knowledge building is linked to learning outcomes (e.g., final course grade) this is an important consideration for teachers. Attending to the many ways that we as instructors can endorse endogenous instrumentality for our students and increase their use of knowledge building strategies and furthermore, learning outcomes, is important.

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APPENDIX A

REVISED EXOGENOUS SUBSCALE FROM THE PERCEPTIONS OF INSTRUMENTALITY SCALE, NOW REFERRED TO AS EXTRINSIC INSTRUMENTALITY FOR GRADE SUBSCALE

Revised Exogenous Subscale From the Perceptions of Instrumentality Scale. Now referred to as Extrinsic Instrumentality for Grade Subscale.

1. The only aspect of {insert course name} that will affect my academic future is my grade.
2. The only thing useful to me in {insert course name} is the grade I get.
3. The only aspect of this class that will matter after graduation is my grade.
4. To reach my academic goals, all I need from this course is my grade.