Nurses, Managers, and Engineers – Oh My! Disciplinary Perceptions of Intuition and Its Role in Expertise Development

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***Abstract*—This Research Category – Full Paper presents initial emergent themes from our quest to understand the construct of intuition. Our work uses theories of expertise development and dual-cognitive processing frameworks to provide a theoretical grounding to define discipline-specific intuition. We hypothesize that intuition can be observed in disciplinary experts through discussions of experience and decision-making processes. Interviews were conducted with professionals in three fields – engineering, nursing, and business management – that engage intuition in decision-making. A comparative analysis of emergent themes is presented to understand similarities and differences in use and definition across these disciplines. Parallel grounded theory and critical incident technique approaches were used to identify perceptions and incidents of intuition. Results suggest that intuition can be defined as a "sense of knowing" that is context specific and at least partly attributable to experience. Inclusion of multiple fields and comparisons across disciplines form the foundation for our future work focusing solely on engineering intuition.**

Keywords—intuition, decision-making, expertise development, comparative analysis

I. Introduction

Intuition is often colloquially referred to as a "gut feeling" and used as an everyday term that describes unconscious processes in our decision-making. Discipline-specific intuition in high-stakes and specialized fields such as nursing, business management, and engineering is posited to be an essential component of the development of disciplinary expertise. Studies of discipline-specific intuition in nurses and business managers support intuition's importance in expertise; similar research has yet to be widely studied in engineering. A better understanding of the role of intuition in supporting expert decision-making in engineering can provide a foundation for new educational and training initiatives that catalyze development. This study establishes such a foundation for engineering through a comparative analysis with those fields – nursing and business management – that have already investigated professional use of intuition.

We intend to gain an understanding of the context-specificity of intuition within the discipline of engineering by exploring the following research question: How does expertise development and discipline-specific intuition use compare across the fields of engineering, nursing, and business management? Results from this study and future studies on engineering intuition will be applied to identify methods to measure and cultivate intuition among engineering students. These methods are intended to help students develop expertise and build confidence, which could have a positive effect on student persistence, especially among underrepresented groups [1-6].

II. Theoretical Framework

Our investigation of intuition couples theories of expertise development with dual-cognitive processing. This combination provides a theoretical framework for hypothesizing that intuition is observed in disciplinary experts, relies on experience, and emerges in decision-making processes.

An expert has an "intuitive situational response" [7] and strong ability to build associations or run mental simulations [8] that may be gained through experience [9, 10]. These characteristics of expertise imply a speed and automaticity to responses [11, 12] and high knowledge transfer [13, 14]. Responses are governed by decision-making processes and may be arrived at through rational, intuitive, or emotive reasoning [15, 16]. Understanding individuals' decision-making processes in the context of their discipline is believed to offer insight into discipline-specific intuition.

A. Discipline-specific Intuition

Intuition has not been widely studied in engineering to the extent it has been in the fields of nursing and business management. These fields both rely on high-stakes decision-making, with intuition considered an essential element to

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achieve disciplinary expertise [17, 18]. Well-developed intuition in nursing is described as a learned task "autopilot" [19] that results in more positive patient outcomes [20]. Business managers with high levels of business intuition are credited with faster decision-making and increased ability to navigate ambiguity [18, 21]. The construct remains ambiguously defined despite studies in these fields reporting intuition's value in achieving better outcomes.

B. Engineering Intuition

Engineering intuition has not previously been defined in the literature. We hypothesize a definition by considering the relationship between intuition and decision-making with the positive-outcomes associated within nursing and business management. Our proposed working definition of engineering intuition is the ability to: 1) assess solution (or response) feasibility, and 2) predict outcomes and/or options within a scenario.

III. Methods

Our previous work and literature review [22, 23] guided the development and initial testing plan for our interview protocol. Participants included two engineers, two nurses, and two business managers identified through a sample of convenience. Nurses and business managers were included to test our results against previous literature on intuition in these fields [22].

Semi-structured interviews were used to provide flexibility throughout the interview. The interviews were conducted, recorded, and auto-transcribed using Zoom Video Communications software. Transcripts were manually checked for accuracy by a research team member.

The protocol (Table I) consists of six major sections: 1) demographic information, 2) work history, 3) expertise development, 4) decision-making, 5) intuition, and 6) wrap-up. This approach was taken using previous literature from nurses and managers stating that intuition can be learned through experience [18, 19, 21]. The protocol first discusses decision-making to determine if intuition naturally arises. The protocol is designed to react to the interviewee's responses, particularly in regard to discussions of intuition or a closely related topic (e.g., gut feeling, innate knowledge, etc.). An immediate transition is made if intuition is mentioned during the first four portions of the interview. The concept of intuition is otherwise introduced into the discussion around 25 minutes into the 30 to 45 minute interview.

A. Coding Interview Responses

Qualitative analysis of the interview results was conducted by first isolating responses that related to decision-making and problem solving in each interview. Selection of excerpts was determined by the participants' responses rather than the questions asked. All other information was used to provide background information or define terms.

Each selected excerpt was read several times to identify units of meaning for our grounded theory approach. Labels, or codes, were assigned to these units. Related codes were grouped into categories and subcategories to simplify the list of codes. A full preliminary codebook (Table II) was established after several iterations of testing and adjustments.

TABLE I. Interview Protocol

Section	Protocol Question
Demographic Information	State your name.
	What is your academic background?
Work History	What is your current occupation?
	How long have you been working in your current role?
	What were your prior roles?
	What are your general responsibilities in your current role?
	What does a typical day look like for you at work?
Expertise	What do you consider your expertise to be?
	How do you think you developed this expertise?
Decision-Making	How do you make decisions on the job?
	How do you make decisions now rather than when you first started?
Intuition	One thing we're interested in is the role of intuition in the workplace, how would you define intuition?
	Do you think you use intuition? If so how? If not, why not?
	How do you think intuition is developed?
Wrap-up	Ask interview observers if they have anything to add.
	Thank you for your time. Is there anything we missed?

TABLE II. Codebook

Code	Sub-Code
Ambiguity	Uncertainty Lack of Data Puzzle
Time Constraint	Deadline Urgent Quick Turnaround
Risk/Loss	Material Loss: Monetary Job Immaterial Loss: Reputation Self-Esteem
Inhibitors (of One's Choice to Use Intuition)	Negative Emotions: Embarrassment Fear of Being Wrong Punitive Workplace Culture: Chastise Demotion
Facilitators (of One's Choice to Use Intuition)	Positive Emotions: Comfortable Trust Confident Supportive Workplace Culture: Encouragement Praise
Career Experience	Time in Position Newcomer
Learning	Formal Education: School Real-World From Exposure to Unfamiliar Problems: Trial and Error Guess and Check From Exposure to Familiar Problems: Happened Before Trend
Outcome	Sense of Intuition: Gut Feeling Subconscious Success: Solution Win Failure: Wrong Error

The codebook was then used to code all selected excerpts in Dedoose, a web-based qualitative analysis application. Descriptors were then assigned to each participant so that later comparisons of results could be conducted across the three included disciplines. Some units met the criteria for multiple codes, which were used to identify code co-occurrences.

B. Limitations

The primary limitation of this study concerns the participant sampling and sample size. Participants were chosen through convenience sampling and do not represent the full diversity of their respective fields of expertise.

Additionally, the emergence of intuition came naturally during some interviews. This took the form of a discussion around tangentially related ideas, which made the transition to discuss intuition straightforward. Pivoting to intuition for those interviews where intuition or a related concept was not brought up revealed itself to be much more challenging for the interviewers.

C. Researcher Positionalities and Epistemiology

We have undertaken this line of research because we believe engineering intuition is an existing construct that plays a role in the decision-making processes undertaken by engineering students, faculty, and practitioners. These beliefs have the potential to impact how interviews were conducted and the resultant data.

IV. Results and Discussion

Our qualitative analysis of the interview excerpts revealed similarities and differences in how each discipline and individual viewed their expertise development and intuition use. All disciplines similarly reported learning from exposure to unfamiliar problems. They also similarly noted formal education helping with expertise development.

In the following discussion, E1 and E2 denote specific engineer participants, N1 and N2 denote specific nurse participants, and B1 and B2 denote specific business manager participants.

A. Emergence of Intuition

Intuition emerged naturally through tangential ideas in three of the six interviews. This included both nurses and one of the engineers.

> E2: "I find myself when being faced with these situations…going through the Rolodex in my mind of…what was the outcome of a decision that I made, …how is that decision affecting the outcome of the experiment, as well as…the internal kind of encyclopedia of information that I…acquired over time"

> N1: "You've noticed the signs,…you become accustomed to, like, I've seen this several times before and this baby is presenting the same way as all these other babies that we ended up having to do A, B, and C for…experienced nurses cue into that earlier…and they're able to, you know, recall that, and they just they know that this is not right and this is not going the right way"

> N2: "I think over the years…after you gain experience and you start feeling more comfortable with things, calling doctors becomes second-nature"

B. Defining Intuition

Once explicitly brought up, participants all uniquely described intuition and how one develops it, to include:

> E1: "Some people just have a sense for it more naturally like they can tell what's going to be more important faster than others. It's almost like, I don't want to say a mindfulness thing, but an ability to step back and look at the bigger picture and not get hung up on the details looking too closely at something," and that it's "80% developed over time"

> E2: "I think that gut feeling is sort of based on the Rolodex of results from the past as well as just knowledge gained over time"

> N1: "As much as I'd like to think it's a nursing intuition, gut feeling, I feel like nursing intuition is…really just based on prior experience and having been caught in that situation before"

> N2: "They always call it a nurse 'spidey-sense,' but it's your intuition on what could potentially go wrong or if you get a feeling about this patient just doesn't really look right. I think it helps when you have more experience, and it gets easier to do"

> B1: "Intuition plays a role in every part of management, all the time. There's always…a gut feel. There's always a sense of this is where we should be going or what we shouldn't be doing," and "it's what you see as your comfort level"

> B2: "Intuition comes to play when you don't have all the information. And I think maybe the more experience you have in the field or with the team, maybe the more you're willing to make decisions without all the facts and data"

The link between intuition and experience mentioned by both N1 and N2 aligns with nursing models of expertise [17]. N2's additional comments on how experience increases intuition is also aligned with the existing literature on nursing intuition [19].

B1's and B2's respective assertions that intuition is used in every part of management and that it is mainly used when there is a lack of data align closely with past research on managerial intuition [21]. B2 mentioned personal use of intuition significantly more than B1, which may be due to B1's declared preference for using data, rather than intuition, to drive decisions.

C. Developing Expertise through Experience

Additional similarities were found between two disciplines. For example, engineers and nurses reported learning and expertise development from exposure to unfamiliar problems and real-world training. Only E1 addressed real-world training among the engineers. Managers, specifically B1, only reflected on unfamiliar problems once, and neither manager mentioned real-world training in helping them develop expertise.

Direct responses to questions about intuition revealed consistent mentioning of factors related to career experience, time constraints, and exposure to familiar problems, but no significant consistency was found across all three disciplines. Reflecting findings in other studies on nursing intuition, we found that nurses frequently cited experience as a major factor in one's development of expertise and ability to effectively use intuition [17, 19, 24]. They mentioned experience far more (33 times) than engineers (13 times), and managers (7 times). Nurses also notably mentioned a sense of intuition (25 times) much more than engineers (10 times) and managers (11 times).

Managers and nurses both demonstrated the same number of instances mentioning time constraint in the context of their decision-making (3 times), while engineers mentioned time constraint slightly more (6 times). Managers and nurses also demonstrated similarity in mentioning ambiguity in the context of decision-making and problem solving; N1 and B2 noted ambiguities significantly more than N2 and B1. Engineers did not mention ambiguity in their descriptions of similar scenarios. Overall code occurrences are summarized in Table III.

D. The Role of Risk

Though risk was rarely addressed in describing the context of decision-making and problem solving, both managers and engineers mentioned risk. E1 and B2 both mentioned immaterial risk to their reputations, but only B2 mentioned material risk (e.g., credit) as well. Those who directly discussed risk did it in the context of decision-making and whether they would use intuition.

> B1: "If there wasn't too much danger of making the wrong decision, I might go out on a limb and go with my sense, with my gut."

E. Faciltators and Inhibitors

Managers discussed facilitators of their choice to use intuition significantly more often than they did inhibitors of one's choice to use intuition. Facilitators were discussed by managers (12 times) significantly more often than engineers (4 times) and nurses (3 times). B1 often described decision-making in the workplace as a "penalty free environment"

> B1: "There is no bad idea, and this is a penalty free environment. Nobody's going to get penalized for saying something."

B2 repeatedly mentioned the feeling of trust among coworkers.

> B2: "I pull up that person to tell me what she thinks, and I trust her to tell me."

Alternatively, nurses more often (12 times) described inhibitors than they did facilitators and generally much more than engineers (3 times) and managers (1 time). For example, when discussing their decision-making of calling doctors in for a patient, N1 and N2 highlighted the negative emotional and workplace environmental aspects that have driven less experienced nurses to not heed their intuition.

> N1: "I think that more experienced nurses will end up hitting the button [to alert the doctor] quicker…I've watched these new nurses learning, and I think it's partially due to fear of embarrassment."

> N2: "As an early nurse, you're extraordinarily timid to call the doctor, especially if you have a bad experience, which you will because the doctors can be sassy sometimes."

These findings are consistent with past studies that suggest supportive workplace environments accommodates a nurse's use of intuition more than punitive ones [24].

Nurses and managers seemed to focus more on either facilitators or inhibitors of their choice to use their intuition, but engineers in total described facilitators and inhibitors nearly equally. E2 accounted for most of the descriptions, as E1 only mentioned inhibitors once and did not mention facilitators. E2 directly addressed the positive correlation between confidence, which is a facilitator, and experience. This bears similarity with findings noted in another study on confidence, which suggested that confidence in decision-making increases with experience [25].

> E2: "I'm more comfortable making that type of [bold] statement again…probably also building some more confidence as well with just more, more experience"

Finally, managers and engineers both brought up successes when discussing the outcome of their decision-making process and possible use of intuition. The nurses did not mention outcomes at all except for one exception regarding a failure.

F. Code Co-occurrences

Several notable code co-occurrences also presented in the data. E2, N2, B1, and B2 reported experiencing positive emotions when using intuition. Conversely, E1, E2, N1, N2, and B1, reported feeling negative emotions when describing cases in which they did not use intuition. Sense of intuition occurred most with exposure to familiar problems. Failure and sense of intuition were never reported together. This is an interesting finding because people might take risks, but intuition is not used to describe the unsuccessful decision-making and problem solving in those risky situations.

TABLE III. CODE OCCURENCES BY DISCIPLINE

Code/Subcode		Engineers		Nurses		Business Managers	
		E1	*E2*	*N1*	*N2*	*B1*	*B2*
Ambiguity		0	0	4	1	1	5
Time Constraint		2	4	1	2	1	2
Risk	General Risk	0	2	0	0	3	3
	Material Risk	0	0	0	0	0	1
	Immaterial Risk	1	0	0	0	0	1
Inhibitors	Negative Emotions	1	2	5	4	1	0
	Punitive Culture	0	0	0	3	0	0
Facilitators	Positive Emotions	0	4	0	2	3	4
	Supportive Culture	0	0	0	1	3	2
Career Experience		6	7	17	16	1	6
Learning	Formal Education	2	1	1	3	0	3
	Real-World Training	4	0	6	3	0	0
	Exposure to Unfamiliar Problems	4	3	4	2	1	0
	Exposure to Familiar Problems	1	6	5	3	1	4
Outcome	Sense of Intuition	4	7	11	14	3	7
	Successes	1	3	0	0	1	1
	Failures	0	0	1	0	2	1

V. CONCLUSIONS

The engineers, nurses, and business managers interviewed in this study all reported their perception of intuition as an existing and important construct. Aligned with prior literature, interviews highlighted the connection between intuition and prior experience in the context of expertise development. The use of intuition was evident in decision-making processes as predicted, and governed by assessment of risk, inhibitors, and facilitators to varying degrees by individual and discipline. Notably, managers most often reported facilitators that allow for the use of their intuition, while nurses leaned toward mentioning inhibitors. This is interestingly contrasted with nurses mentioning intuition at a rate of three times more than the other discipline participants. Business managers reported intuition as key when navigating decisions with incomplete data. Nurses emphasized the role of intuition in their ability to respond more quickly to situations. One engineer explicitly tied intuition, developed through experience, with increased confidence in being able to make decisions.

VI. IMPLICATIONS AND FUTURE WORK

This study has contributed a codebook informed by engineers, nurses, and business managers on development of discipline-specific intuition. Our findings have shown similarities and differences across fields as to how intuition develops with expertise. Alignment of our findings with the literature available in nursing and business management further supports the legitimacy of the codebook and its application in the field of engineering.

Future work entails applying our new knowledge to the field of engineering to fill the existing knowledge gap around the definition and development of engineering intuition. We will apply a grounded theory approach to interviews with practicing engineers in various subfields, industries, and at differing career stages using our interview protocol. Our ultimate goal is to further unlock the secrets of intuition and its role in expertise development and decision-making in the engineering profession.

We believe that studying and gaining a better understanding of intuition can have greater impacts beyond achieving expertise, including fostering a sense of confidence as described by E2. Confidence is known to be a key contributor to persistence in engineering, particularly within underrepresented groups [1-6]. Development of intuition may have positive effects on student persistence. This contribution will not only shed light on engineering intuition, but will provide the base to encourage greater focus on developing engineering intuition in the engineering classroom.

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