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Cogenerative Dialogues, Emotional Conflicts, and Polyvagal Theory: Links to Science Learning.

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Hsu presented a case that cogenerative dialogues (hereafter referred to as cogen) can create an emotionally safe environment to address conflicts in a project-based science internship program. The mentor team comprised an immunologist, Dr Mac, who was supported by two teaching assistants, Ms Karen and Ms Rachel. An event, called "Lucy incident", was selected as the context of the study. One of the teaching assistants felt insulted by the allegations attributed to Lucy about the irrelevant reading assignment that delayed the progress and learning of the interns. The recount of contentious comments made by Lucy over lunch led to an emotional outburst, followed by an "emergency cogen," during which strong emotional reactions from the mentor team was expressed with the revelation of dissatisfaction with the students' responsibilities in the project. The strong emotional reactions resulted in rules of cogen such as agency and respect, being forgotten. In the subsequent "cogen" after the emotional eruption, a hearty conversation ensued between the mentor and the students, resulting in interns' self-reflection and reaching a consensus to exercise self-discipline to address the issues raised by the mentor team. Hsu thus concluded that the cogens are responsible for transforming the emotional climate in this situation because of the respectful communication that emphasized equality of power, thereby increasing reciprocity and synchronicity among the mentors and students. Polyvagal theory was used to explain for the emotional responses.

After reading this intriguing account, two main questions surfaced about the alternative scenarios and interpretations presented in this study:

1. Do the cogens related to the "Lucy incident", the "emergency cogen" and the ensuing hearty conversation count as cogens? Could the conflict be avoided if the mentor team followed the principles of cogens in the first place?
2. Beyond using Polyvagal theory to account for observation of emotions, are there alternative theoretical lenses that we could apply to make sense of the regulation of emotions in the cogens?

The lethal mutation of cogens

We start by recounting the reactions and responses by the mentor team during the "Lucy incident" and the emergency cogens they initiated. During the "Lucy incident," Ms Karen (one of the teaching assistant), felt insulted by the allegation attributed to Lucy and fought back by revealing to the students that they had not mastered the necessary laboratory techniques and the mentor team decided to keep quizzing them and practicing the techniques because the team was responsible for the outcomes and could lose their jobs if there were serious errors in the experiment. After reporting back to Dr Mac (the chief mentor, an immunologist), Dr Mac decided to stop all laboratory activities, fire Lucy, and call for an "emergency cogen". During the "emergency cogen," Dr Mac expressed his disappointment and dissatisfaction with the students' performance, while Ms Karen chided the students for their tardiness in completing the assigned readings. The students showed varied reactions, from being shocked, immobilized, to confusion about why the issue raised became such a serious problem.

Noting the behaviours, talks and emotional responses of the participants during the two cogen sessions described above, and comparing with the cogen rules and structure (Figure 1), as well as heuristics for cogen(Appendix 1), the cogen related to "Lucy incident" and the emergency cogen bear little resemblance of the characteristics of cogens. There were no equal turn taking and time for the "conversation", the mentors did not focus on the positives, and there was no co-generation of solutions. Hsu acknowledged these:

> The idea of being insulted is alien to cogen, since offense should not be constructed because someone said something that differed from what Karen regarded to be truth. Karen's stance and indignation were consistent with traditional power structures in which student voices needed to comply with extant power structures.

Hsu described the incident as a "dressing down" rather than a cogen. The mentors exploded with "the long-suppressed negative emotions," and the power structure reflected that of a traditional classroom. Clearly, the mentors had violated the rules of cogen during this emergency session. In addition, the unleashing of long-suppressed negative emotions suggested that the mentors had not been truthful about their feelings and had not conveyed the feedback honestly to the students in previous cogens. This is yet another violation of the rules and intentions of cogens. One cannot help but wonder if the mentors felt that the interns were too immature to understand the situation in previous cogens, whether the mentors understood the affordances and intent of cogens, or if they bore doubts about the effectiveness of cogen in the establishment of meaningful internship experience. The emotions experienced by the mentors and interns during cogens before the "Lucy incident" would be helpful in uncovering the reasons for the suppression of emotions.

Does the "hearty conversation" that ensued count as a cogen? It was observed that the situation was more cordial and controlled, based on the lack of descriptors of negative emotions and the content of the conversation. Intriguingly, Hsu described the cogen as "consistent with hegemony" and that the "students accepted their oppression as part of the way it ought to be and adapted their practices accordingly." It was reported that Ms Karen also tried to find out why the interns had not asked questions and talked about what could be improved in the internship. This appeared ironic because when the interns spoke honestly about areas for change in the "Lucy incident," but it inadvertently triggered an unanticipated violent response. The interns also told Ms Karen that they did not want to ask questions in order not to sound disrespectful. The interns accepted their oppression and co-constructed (among the students) solutions based on the assessment that they (the students) were at fault. The interns concluded that the problems were caused by themselves and as such, they had to fix their attitudes. Although Hsu described this dialogue as a "hearty conversation," it undoubtedly reflected the inequality in power and the hegemony of the mentors. The mentors failed to reflect on what had gone wrong and what they could have improved. The mentor team seemed happy that the interns were trying to improve and that Dr Mac declared the power of the "magical circle" in resolving the situation. Is this considered a cogen? From the descriptions, it was hardly so.

This reminded us of what Brown and Campione (1996) referred to as "lethal mutations" (p. 292) to well-intended pedagogical interventions, in this case, a lethal mutation of the fundamental principles and objective of cogens. An alternative interpretation to the events described was that **cogens** was not implemented in the true spirit of equality of power.

Could the mentor team have responded differently? If the cogens principles were adhered to and enacted with high fidelity, the following hypothetical scenario could happen: The cogen sessions served as a non-threatening environment to surface and discuss the suggestion attributed to Lucy. Respecting the interns' voices and treating this as a legitimate feedback about how the interns perceived the situation, Ms Karen could have probed further to find out whether all the interns had felt the same way, instead of reacting by fighting back. Rather, in the spirit of empowerment and respect, Ms Karen could take the opportunity to explain the rationales of assigning the reading assignments, and explain to the interns the criticality of mastering the various laboratory techniques. Subsequently, Ms Karen and the students could co-construct the possible solutions to address the issue raised, including what the mentor team could do to improve the

relationships and outcomes, and the actions that the students could take to meet the expectations and objectives of the internship program.

In the paper, Hsu concluded that cogen was used as a pedagogical tool to address emotional conflicts, and that cogen were used as a formative assessment to address students' concerns, to address students' procrastination, and to address the instructors' challenges. We venture an alternative interpretation based on the case descriptions, although we acknowledged that Hsu could have more emic experience and insights into the events. The case descriptions suggested an evolving nature of cogen sessions were being co-constructed by the mentors and the students, as they made adaptive adjustments to the cogens rules and structures. The participants were unable to portray the principles of cogens as evident from the unequal power relationships displayed. The lack of trust and absence of honest conversations had not create a fully safe environment; the mentors held back their negative emotions about their dissatisfaction with the students' progress while the students did not raise questions for fear of showing disrespect. The maladaptive behaviours of the mentors escalated the issue related to the "Lucy incident" to a highly emotionally charged event, and institutional power was summoned to regain control and to demand respect. The expected decorum of cogens were ignored in the midst of overwhelming negative emotions of anger and confusion. There was a missed opportunity to use the "Lucy incident" to launch a hearty, sincere and honest conversation. The students succumbed to the hegemony and co-constructed ways to align their behaviours to the mentor's expectations. The mentors were eventually happy the "magic circle" worked because they saw the outcomes they wanted, but there was little mention about changes made on the mentors' parts to improve the internship experience. In short, it may not be the case that cogens helped to resolve the emotional conflicts, but adapting to cogens provides the context to which these highly-charged emotional events unfold, and it was resolved as the participants engaged in repair strategy that appeared to have resolved the tensions at that time.

The usefulness of polyvagal theory in this case study

Accounting for emotional responses of the participants forms a key theme in this study. In this regard, polyvagal theory (Porges 2007) was used to explain three types of emotional responses: the immobilization system (Vera froze, cried and left the room), the mobilization system (the mentors fought back after feeling insulted), and the social engagement system (the hearty conversation). We present an alternative perspective about the usefulness of this theoretical perspective in this case study. First, while there are many studies in psychopathology (for example Beauchaine, Gatzke-Kopp and Mead 2006) and psychology (for example Hastings, Nuselovici, Utendale, Coutya, MaShane and Sullivan 2008), done using polyvagal theory, there are also research evidences debating about the validity of polyvagal theory. Typically, critics of the polyvagal theory (see Berntson, Cacioppo and Grossman 2007) argued that there is little compelling scientific and measurable evidence for two out of the three premises of the polyvagal theory. For instance, in the work of Cheng, Zhang, Guo, Wurster, and Gozal (2004), they showed that nucleus ambiguous (NA) and dorsal motor nucleus of the vagus (DmnX) project to unique populations of cardiac principal neurons and suggested that it was evidence that the NA and DmnX may play different roles in controlling cardiac functions. The fundamental roles of NA and DmnX hence did not appear to support the premise that neurogenic bradycardia and RSA are mediated by different branches of the vagus and need not respond in concert.

Second, and more critically, while polyvagal theory explains the autonomous emotional responses that are related to primitive animal instincts (reactions in a danger situation), what are the options that are open for intervention? Hsu recommended "educators urgently need educational intervention studies demonstrating ways to help students and teachers regulate their emotions." To this end, perspectives of emotions linking emotions to cognition could be considered.

Neurobiological basis of emotion and cognition

From a neurobiological perspective, learning results from experiences that lead to long-term changes in brain networks (new connections or pruning), and the effect is often reflected in behavioral potential in respond to a situation or a stimulus. The demonstration of reasoning skills and recall of factual knowledge are some indicators of learning. Research in neuroscience has increasingly provided evidence that learning and recall are closely associated with emotion (Immordino-Yang and Damasio 2007; Tyng, Amin, Saad, and Malik 2017). From brain structural and functional images, the limbic system (including the hippocampus and amygdala) that is responsible for emotional processing is also related to learning and memory. The hippocampus, for example, has been shown to support consolidation of new memories, emotional responses, navigation and spatial orientation. The amygdala, adjacent and anterior to the hippocampus, is also involved in emotional processing. In short, the hippocampus works in concert with the amygdala to consolidate our emotions and long-term memories, which provides the neurological basis of a tightly bound relationship between learning, memory and emotions. Other studies have found that emotion and reward may influence learning (Chiew and Braver 2014; Cromheeke and Mueller 2014).

Psychological perspective of emotions in academic settings

From a psychological perspective, many theorists regard emotions as multi-componential processes (e.g., Frijda 2001) which include "appraisal, subjective experience, physiological change, emotional expression, and action tendencies" (Sutton and Wheatley 2003, p. 329), and these components could have some partial influence on one another. Relevant to learning, there are perspectives of emotions that acknowledge the cognitive aspect of emotions. For example, Forgas (2001) described emotions as "intense, short lived, and highly conscious affective states that typically have a salient cause and great deal of cognitive content." (p. 15) Researchers studying emotions in learning have reported that emotional experiences not only have the capability of influencing cognitive development, but also affect learning processes in students (Lang, Dhillon, and Dong 1995). Emotions can modulate the content of cognition (memory), process of cognition (information processing), motivation, and decision making (Forgas 2001).

Pekrun and co-workers studied students' experiences of a diversity of emotions in academic settings. Pekrun, Goetz, Titz, and Perry (2002) held that academic emotions play a significant role in students' motivation, learning strategies, cognitive resources, self-regulation, and academic achievement, as well as in their personality and classroom antecedents. Their research findings highlight the need to conduct studies that examine the effects of students' emotions on their cognitive processes and performance. Studies by other researchers also indicated strong connections between students' emotional development and their academic and well-being outcomes (Schonfeld et al. 2015; Sklad, Diekstra, Ritter, Ben, and Gravesteijn 2012).

Emotional regulation

Of particular interest to this case is the application of emotional regulation. Besides asking the question of "what happened during the 'Lucy incident'?" we could ask, "Given the unfortunate upheaval of emotions as a result of the 'Lucy incident', what could the participants do to regulate their emotions and to prevent or to respond in amicable manner in future occurrences of similar situations? How does cogens relate to the emotional regulations?

We can consult research on emotional regulations, such as studies by Gross and his colleagues. Gross and Thompson (2007) provided a processual account of emotion: A situation giving rise to emotions, attending to this situation, appraising the situation and assigning meaning to it, responding and acting in certain ways. Based on this process, there are several junctures one can regulate emotions. Selecting a

situation or modifying a situation; deploying one's attention; changing cognitively how one appraises a situation, in other words, changing interpretation of meaning of the situation; and modulating one's emotion.

Applying this emotional regulation model to the "Lucy incident" means that there are some concrete strategies that the participants could try. The following table summarises some potential strategies by both parties, mentors and students.

Emotion regulation strategies	**Mentors**	**Students**
Situation selection	Develop awareness of situations that could trigger extreme emotional responses.	Providing feedback in a sensitive manner to avoid hurting the feelings of the mentor.
Situation modification	Rather than *fighting back*, work out a script of what to do or what to say when a similar situation arises.	Rather than *freezing in fear* or running away from the situation, work out a script of what to do or what to say when a similar situation arises.
Attention deployment	Learn to direct attention to the positives, rather than dwelling or ruminating on the negatives.	Learn to direct attention to the positives, rather than dwelling or ruminating on the negatives.
Cognitive change	Learn to appreciate the cogens rules to respect students' voice, and to understand that the students are trying to provide a feedback. Learn to reflect on what the mentors can also do to improve the situations.	Learn to understand or find out reasons for actions by the mentors. Understand why the mentors are feeling insulted by the comments.
Response modulation	Adopt ways to regulate emotional responses such as taking deep breath, intentionally control impulsive responses, or asking for cool down time before further conversation.	Adopt ways to regulate emotional responses such as taking deep breath, intentionally control impulsive responses, or asking for cool down time before further conversation.

Moving back to our alternative interpretation, it was not the cogens that regulated the emotions, but the participants' lack of understanding of cogens that triggered the events and the subsequent strategies to deal with the situations seemed to involve violation of cogens rules. We could add to the cogens heuristics about emotion regulation strategies. For example, how does one strive to have all voices heard and value different perspectives if one cannot control own emotions? The emotion regulation model by Gross and Thompson (2007) could provide the guidance. Some examples are suggested:

1. Identify situations or triggers that could cause negative emotional responses.

2. Work out a script to talk or act when these situations arise so that my talk or actions will maintain respectful.
3. Attend to the positive aspects of talk.
4. Learn to clarify meaning for negative aspects of talk as interpreted by me.
5. Learn to understand the perspective of other that give rise to negative aspects of talk as interpreted by me.
6. Identify and be aware of physiological responses when my negative emotions are building up.
7. Exercise response modulation strategies when my negative emotions are building up.

There is hence value in progressing from a focus solely on the emotions and their reactions to also take into consideration the social context with which the emotions are manifested, and the need to take into account the participants' expectations of the experiences (Kagan 2018). The strategies such as situation modification and cognitive change help to calibrate and set expectations for the context of laboratory work as well as cogens. As highlighted by Kagan (2018, p. 81), "(t)he brain of an awake animal or person is continually priming the brain sites that usually respond to the event most likely to occur in that context." As such, events (such as emotional outburst or unexpected criticisms) that falls outside the expected boundary has a higher probability of activating brain centres that will in turn change the brain and psychological state (Kagan 1970). To conclude this commentary, we like to suggest that in order for cogens to be a "magic circle" to create a safe environment for learning, besides understanding the principles of cogens, expectations from various participants also need to be set. In the event of a violation to expectation, emotion regulation strategies can be incorporated to enable participants to better understand their emotions and reactions.

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