Why a PhD? An exercise with LEGO®. Using novel communication tools to express multilevel complex messages

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Abstract

STEM doctoral students are typically regarded as strong model builders but weak reflective communicators. Expressing one's motivations to undertake a PhD degree requires the elaboration of a multi-level complex message, as reasoning and emotion are often interwoven. Newly enrolled doctoral candidates were asked to explain 'why a PhD' using LEGO® pieces to help them express beyond words, with constructions, through similes and metaphors. The use of LEGO® was intentional for two reasons: it gave them a visual and kinesthetic outlet for enhancing and deepening their reflections and message; and it put them at ease, in 'play mode', which allowed them to access aspects of their psyche not typically exploited in technical conversations. They constructed stories, created characters, and produced metaphors to channel and express what their motivations, drives and purpose were. The most common types of metaphors used were visual, ontological and spatially related. Their level of satisfaction was high in that they felt more confident explaining an otherwise elusive question that they had found difficult to address, articulate and communicate previously. The individual's commitment to building correlates positively with the sophistication of the metaphors created. A larger than expected frequency in the use of literal similes was also observed, which was attributed to a lack of engagement, poor language skills and cultural differences. As a secondary aim, this exercise – where they shared deeper meaning emotion-laden messages on journeys and personal growth – intended to increase *cohortness*, togetherness and the emergence of a peer-support network.

Keywords
Constructionism, PhD, motivation, LEGO®, metaphor, reflective learning.

1. Introduction

The understanding of the true motivations and drivers for why a post-graduate student wishes to do a PhD and enroll onto a doctorate program at university is a valuable piece of information. Those personal and individual motivations set the foundations of their doctoral journey. This journey is far from straight forward and seamless. It can be a trying venture that changes the candidate forever. In our role as supervisors and PhD project directors, we ought to support the student when hiccups occur. An effective way to support the student through this personal and professional journey is to utilize and re-call upon their motivations. However, these are often not well articulated or communicated by the candidate because they are typically of a multi-layered, multi-faceted, complex nature. At times, these are not even well understood by the candidate themselves.

By the time they reach graduate education, engineers and scientists have not exercised communication and reflective skills as much as their counterparts in Business & Management, Social Sciences and the Arts. This situation places them at a disadvantage when they are required to work in multidisciplinary teams deployed in Industry. Communicating a complex message can prove a challenge for STEM graduates. On the other hand, scientists and engineers are typically comfortable in the conceptualization and building of models, they are used to being involved in model making activities, whether physical or virtually. This is a skill and mindset that can be exploited to encourage deeper reasoning, reflection and exploration.

As part of the multimodal level approach adopted by the EPSRC Centre for Doctoral Training in Embedded Intelligence (www.cdt-ei.com), based on andragogy and heutagogy principles that best suit the pool of PhD candidates under training [1], we offered them LEGO® bricks as a new language for communication. This was our opportunity to introduce a pedagogical approach to constructionism (creating knowledge through building a model, a prototype) in their curriculum *versus* instructionism (when knowledge is given, found) [2]. By turning abstract into tangible, understanding improves. The use of LEGO® bricks shifts the learner's expression to metaphors and 3D representations, aiding them to express complex ideas with entwined emotions [3]. Equipped with this new language, they can make new discoveries, challenge their beliefs and explore new thinking [4].

LEGO® has developed a type of exercises called LEGO Serious Play® (LSP) that are based on the principle of gamification. This is, when a complex exercise is distilled into basics and bite-sized actions or tasks in an environment of multi-sensorial, commonly awarded with incentives, and in a playful manner. LSP was first developed in 2002 by the LEGO® Group and launched as an open-source community-based model for facilitation in 2010 [5]. A comprehensive summary of the LSP history can be found in [4].

"*LEGO® worked better than spoken words*". The power of the LSP language originates in the combination of several sensory elements (i.e., hands that touch the bricks, eyes that see vibrant colors, ears and mouth to listen to and tell stories) and cognitive engagement (e.g., evoking memories from childhood, following or creating logical building instructions, constructing metaphors). The LSP method harnesses the power of storytelling and the use of metaphors as well as stimulating an emotional response (childhood/parenting nostalgia) at the sight of the bricks. As such it fosters deeper learning through improving self-awareness and developing insight.

Previous research with LSP has been reported in Higher Education with arts students [6], occupational therapy students and staff [7], and nursing students [3] for a reflective exercise on their own learning, with biosystems engineering students to identify skills and discover professional ambitions [8], with multidisciplinary undergraduate student teams to address 'wicked' problems [9], with teaching practitioners for assessment discussions [10], and with staff in an Education School to identify university's strategy and planning [11]. The use of LSP opens the door to the externalization of ideas more explicitly, with a deeper meaning,

facilitates internalization of new knowledge and accelerates socialization by structuring the interactions within the group [9]. It opens the door to 'play', facilitates communication by lowering the barrier, putting people at ease which fosters students' insights and self-awareness reflections. It entices to use metaphors.

A metaphor is a form of figurative language departed from literal definitions that enriches the message by creating analogies. Because it is information-rich, metaphors are useful to convey complex, multi-layered information that carries an emotional element because it requires the receiver to access their own experience, memories and narrative [12].

Having established the benefits of using LEGO® bricks to elicit metaphors, access deeper levels of reasoning, interpretation and communication, we wanted to explore with newly enrolled PhD students their motivations and reasons as to why they wanted to do a PhD. The primary aim was to capture their implicit expectations from the program and to learn more from each individual, with the purpose of better pastoral support along their doctoral journey. To the best of our knowledge, the use of the LSP® technique has not been used to explore motivations and drivers in the newly enrolled doctoral candidate. The secondary aim was to foster a peer-supportive environment and the gestation of a social network, i.e., cohorting.

Once a safe environment was forged, the candidates were asked to "build" an answer to the question 'why a PhD' individually, without constraints on number of LEGO® pieces and in a nurturing atmosphere. They were then asked to present their constructions to the plenary in turns, while the rest listened. The descriptions were recorded and the arguments analyzed to identify the frequency and types of metaphors used in their descriptions, along with a scoring with regards to their engagement, creativity in the use of the bricks and body language. Student experience was evaluated through a post-event survey collected anonymously. The value of the LEGO® exercise was also evaluated against the LSP framework, with recommendations and lessons learnt.

2. Methodology

This exercise took place at the start of their PhD degree, on the last day of their induction week. Three cohorts of 3 consecutive years participated in this activity. Year 1 cohort consisted of 19 students, year 2 had 12 students and year 3 18 students, bringing the total to 49 students involved in this exercise. The PhD candidates were videoed and photographed during the exercise, and this was done with their acknowledgement and permission. They were given a fixed amount of time to make a construction (30 min) using the bricks as they best chose. Each year, they had access to 500+ pieces, bricks, connectors, mini figures (humans and animals) without constraints placed on how many pieces to use per person or what type of pieces to work with. They built their constructions individually. After construction time came to an end, the candidates presented individually to the cohort in a plenary mode. Their descriptions were captured in video and photo format and anonymized to comply with GDPR requirements. The videos were analyzed and tabulated using the metaphors descriptions as in [13] by two program directors independently. The types of

metaphors used were noted per student, but not the quantity of them used. The metaphors were given a weighting, as per Table 1, and the totals averaged across years. The participant's approach and attitude to the exercise were also scored (0-5) to describe their level of engagement with the exercise, their creativity in the use of the bricks/objects and their body language and non-verbal communication when presenting to the plenary.

Table 1: Description of metaphorical symbols considered in this study, as per [13], and the weighting given for their analysis and quantification. The 'tenor' is the *thing* described; the 'vehicle' is the figurative language used to create an analogy.

Type	Brief description	Weighting[¥]
Simile	It is not a metaphor, it is a literal construction, a scale model	0.5
Personification	Awarding human characteristics to non-human items	1
Hyperbolic	An exaggerated statement	2
Visual	An image that forms an analogy	1
Absolute	When the tenor and the vehicle are completely unrelated	2
Conventional	As per language convention, part of our language	1
Ontological	Non-physical (e.g., emotions) compared to physical things	2
Orientational	Use space and direction in the description	2
Container	Being inside or outside something; the holder	2
Complex	Two or more metaphor stacked on top of each other	3
Literary	Creative, poetic, unique description of the tenor	4
Recent	It refers to new developments in society, technology, culture	2
Extended	There is a story beyond one sentence, needs elaboration	3
Pataphor	It creates its own context; even an imaginary world	4
Implied	Submerged, implicit, incomplete, the tenor is not named	2
Mixed	Unrelated two metaphors used together	2
Primary	The tenor is abstract and the vehicle concrete	2
Root	Includes a metanarrative, and entire new worldview	4

[¥] Indicates level of sophistication, imagination, creativity and articulation of the language

A week after this exercise, the candidates were asked for feedback on the exercise, esp. on the merits of the tool to facilitate their message and scaffold their arguments, and how they perceived the tool had allowed them to convey a multi-dimensional and complex message marrying technical details and personal, reflective feelings. These statements were received anonymously in a written format and their quotes used to aid our observations in the discussion section below.

3. Findings and Discussion

This section is divided into two parts: the first one deals with the analysis of the descriptions created and communicated by the students, along with their level of engagement in the exercise; and the second part delves into the successes and shortfalls the exercise had, considering the premises set out by the LSP framework.

3.1 Use of metaphors, storytelling and participants engagement

The symbolic representations of 'why a PhD' had a marked metaphorical content, dominated by the visual, ontological and primary types, followed by the personification, orientational and absolute (Figure 1).

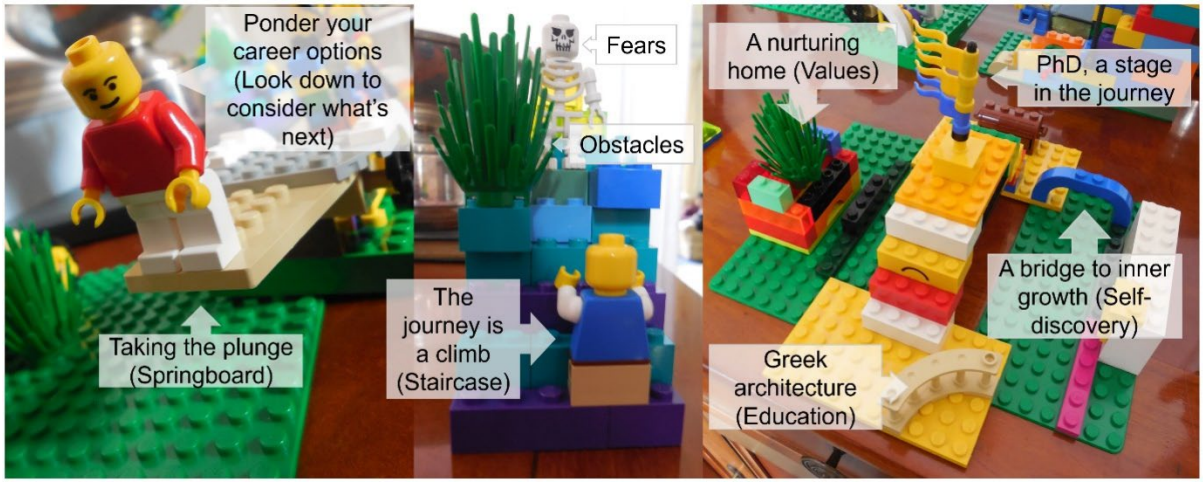

Figure 1: Three exemplars of constructions with annotations depicting a few of the analogies described by the participants. Tenors and vehicles of higher metaphorical symbolism chosen.

On the other hand, similes (i.e., mimics without a metaphorical content) were also frequently used and typically not in conjunction with metaphors. A participant would construct a mini-rig or prototype and describe literally without figures of speech. The least resourced metaphor types were recent (nil), mixed and literary (Figure 2). This gives an indication of the type of linguistic tools and resources STEM graduates have, likely resulting from their undergraduate education and training (i.e., visual, spatial, abstractive, quantitative).

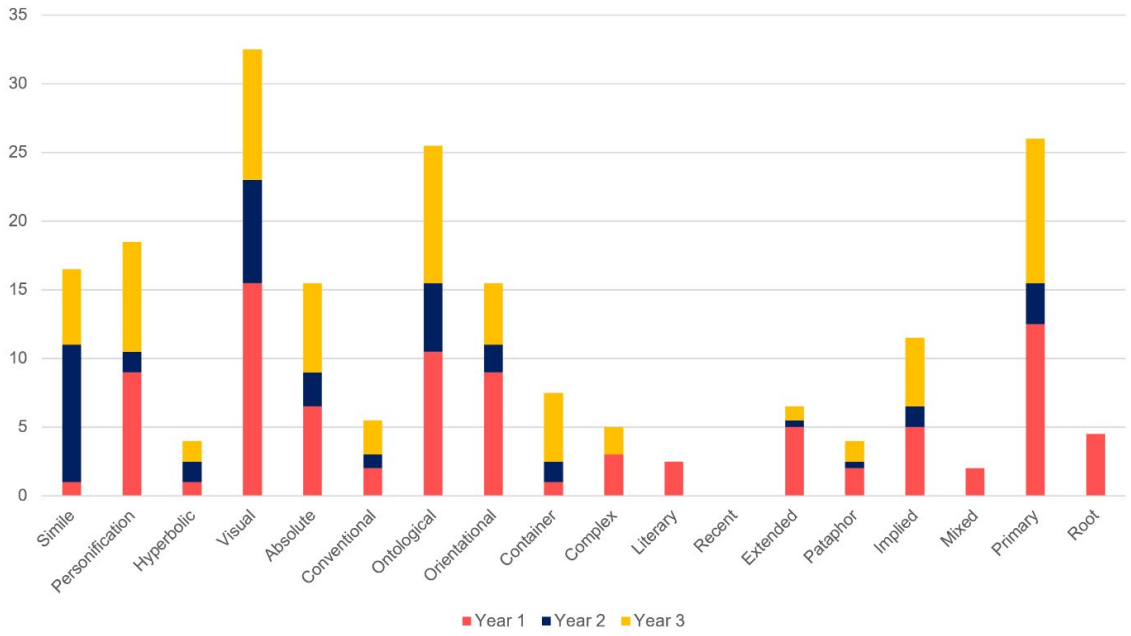

Figure 2: Frequency of use of metaphors (weighted) per cohort. The most frequently used metaphors were visual, primary and ontological. The least were recent, mixed and literary.

We also wanted to investigate whether a greater use of metaphorical content correlated with the participant's levels of engagement, creativity in the use of the LEGO® pieces and body language when describing their construction. Figure 3 presents the results from the analysis. While a positive relationship could be justified, we would like to draw attention to three distinctive areas in this graph.

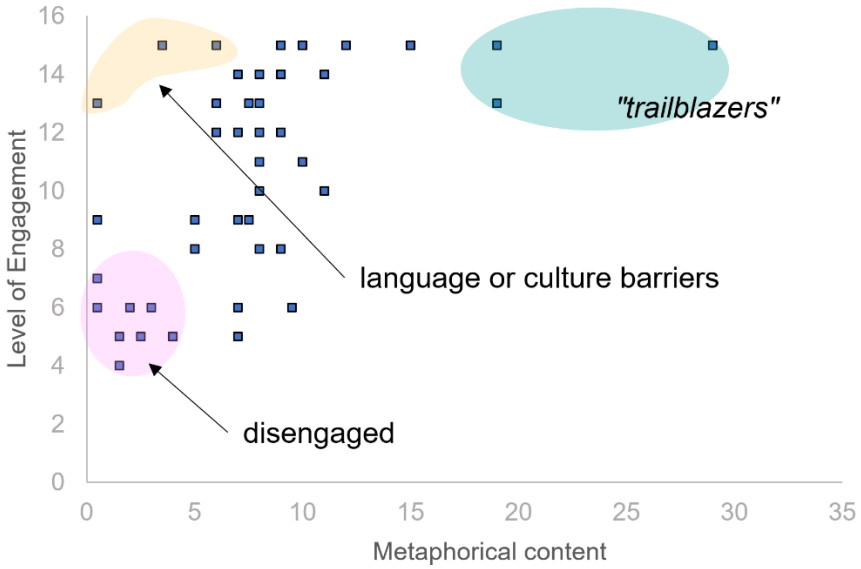

Figure 3: Metaphorical and symbolic use of the language to describe the constructions appear positively correlated with the participants' level of engagement and passion

Participants with high levels of engagement, excitement and interest in this exercise but low levels of metaphorical use sit on the top left quarter. These are individuals whose mother tongue is not English and it is hypothesized that lack of English language ability may have impeded expression of their personal motivations in depth. In addition, cultural aspects could be at the root of these participants decision to create similes (i.e., mini-models that mimic their actual work) instead of using metaphorical resources. Participants with high level of engagement and enthusiasm as well as an authoritative use of metaphorical speech and representations were students who went on to become very successful researchers and employees. These have been described as 'trailblazers' in [14]. Participants with a low level of engagement and a weaker use of the language (this excludes weakness with regards to mother tongue; put simply, poor storytellers) sit on the bottom left quarter of the figure. These students were either poorly motivated to pursue a doctorate (e.g., those wishing to stay in a comfort zone and postpone the entry to the labor market [14]) or drop-outs who later failed their studies.

The data distilled from this analysis produced a useful and insightful pool of information which came to assist the directors of the program and PhD project in their supportive and coaching roles towards students who required intervention during their studies.
Our pool of participants is too uniform (STEM students) and perhaps too small to infer any definitive conclusion on whether this positive correlation is applicable to other cohorts. The exercise was conducted under very controlled conditions and this may have skewed the

results. Therefore, while we consider the correlation arising from our observations informative from a pastoral viewpoint, this does not imply it is a general rule on assessment of student's achievements and professional success.

3.2 Assessment of framework for the activity

The design of the exercise under the premises of LSP included the following important considerations that we observed:

(1) A 'safe space': as it is important to create an environment conducive to reflection and encouraging for the participants to reason at a deeper level by doing a PhD, this exercise took place on the 4th and last day of their Induction, after the students had had the opportunity to work and socialize together in a residential retreat (including evenings).

(2) Mechanistic rules and guidelines on how to use the LEGO® pieces were explained, but the question to answer ('why a PhD') was left open and vague on purpose. The building of a symbolic representation of their motivations and drivers to enroll in a PhD degree as well as the story, metaphors and language used to explain it were under study.

(3) There were no restrictions on topics or approach on how to use the bricks, or constraints around the number of bricks or objects (e.g., wheels, doors, plants) or figurines (human or animal). Full access to the set was an important consideration in the design of experiment phase to aid an unconstructed message (e.g., if only animal figurines had been available, the student could be bound by metaphors around animals). If access to the pieces is controlled, this has been perceived by others as contrived [15].

(4) Support was provided to students during the exercise, with a constant presence of the tutors and interaction with them, encouraging, challenging and coaching the participants during the exercise.

(5) After the building stage, the participants present their construction using similes, metaphors and other tools for storytelling, speaking one at a time while the others listen in a plenary mode, where each individual's description is listened to in silence and in a respectful manner, while the tutor ensures that each participant has an equal voice. Assessment of the activity was evaluated through a post-event survey sent to the participants within a week of conducting the exercise and the responses harvested within 4-6 weeks after the event.

With regards to (1), (3) and (5), these aspects became very important to ensure the success of this exercise, and the achievement of a safe and nurturing space created by the residential stay (incl. self-perception and teamwork exercises [1]) helped with this. The students used this exercise not only to showcase their construction, but also to learn about others, cementing in this way the incipient peer-support network they formed.

> *"It was really useful to know my priorities better regarding my PhD and also to know a little bit more about my cohort."*
> *"It was entertaining and another chance to get to know people."*

"It definitely is something that should be repeated. It facilitates communication and helps to get to know each other. And it is fun after all!"
"[It was] interesting to see what others come up with in the same exercise and their interpretation on the journey they will take."
"Interesting approach, enjoyed building and discussing it with others"

Items (2) and (4) contain the most challenging aspects of the exercise and have an impact on the outcome of the activity. We observed two main contributors: (i) the definition of 'play' is subjective: while generally the participants would be receptive to partaking in this exercise and 'go with the flow', there were a few students that considered this exercise too childish, not scientific, not serious enough for a PhD level activity. (ii) prejudgment on their own skills: while this exercise's aims were to explore at a deeper level their motivations and drivers to undertake a PhD degree, some students placed more weighting in the construction talents one should have to be successful, missing the opportunity to explore and reflect on their own journey.

Typical statements from participants, who discovered latent insights with an emotional content, and expanded self-reflection in line with reports elsewhere [6, 7], and those whose model making helped them identify creative connections beyond the obvious [16], are of the form:

"This was an entertaining exercise and forced one to consider more fully what one's PhD meant to oneself. This was something that some individuals may not have actually considered previously."
"The idea was excellent, it helped with visualising our feelings, having fun, laughing and returning to our childhood days while gazing at our futures. It helped in alleviating my fears and intensifying my optimism about the 4 years I will spend as a PhD researcher."
"It was enjoyable and I found it helped me to understand better what I am looking for in my PhD."
"The LEGO exercise was a nice interactive way of pointing out what do we think about the PhD. It is interesting because kind of shows how we think and what we can achieve with the things we have available. It was also really creative way of presenting something and relaxing because it promoted relations between the group."
"When building with LEGO, I had to think about every piece [to make it fit the story]. Hence, I was thinking while I was doing my work. It gave me the chance to think the meanings of my PhD career."

However, tensions and dilemmas emerged from those less sure about the LEGO® as aids for storytelling or the construction of metaphors:

"I'm not overly artistic so getting the concept of my PhD having little understanding of [what is] my [project] was challenging. Seeing others' interpretations was good though."

"It was entertaining, though my topic wasn't particularly well-suited to the approach. Trying to combine the "topic" and "motivation" didn't seem to work well together."
"[It] could be more flexible, the story you tell has to conform to available lego bricks"
"Lego was more of a distraction than aid."
"It didn't work for me personally but the youngsters seemed to enjoy it."

Disorientation and rejection experiences may have originated from the ambiguity and openness of the question posed ('why a PhD'). Some participants prepared answers with constructions of mini-rigs and semi-functional models that mimicked their actual work, with a dominant use of similes instead of symbolic metaphorical representations. Others gave the question a spin around their journey as a researcher, both a technical viewpoint as well as their personal development. The former ones would typically consider the exercise constraining and less liberating through the element of play.

Furthermore, familiarity with the LEGO® pieces and construction instructions was an impactful factor. Participants who had not played with LEGO® before or had limited experience reported their discomfort. However, this sentiment was dampened in those individuals who felt supported by the tutors or the peer group, and those who overcame their initial discomfort to embrace the challenge and display enhanced creativity. This effect has been reported in other studies [7].

"It was quite awkward for me to build up something to describe the PhD path especially that I have never used LEGO before. But it was good to see what others built too."
"People inspired themselves from one another leading to recurrent metaphors and concepts […] people seemed to embrace it for the most part."
"I was a little skeptical when I first saw the LEGO, but it was a great task to first think about my own project in an abstract way and second to see other people's reasons for their project. This got over the initial introductions of "this is my project and..." where to be honest I don't think many of us understand our own project, let alone someone else's. Seeing the abstraction of the project helped me get to know the group better."

Because the definition of 'play' vs 'work' is not universal, and because the perceived skills to utilize in a reflective exercise is very subjective, these are the main shortfalls of this exercise when presented to STEM doctoral candidates. In response to that, we recommend the following:

- The tutors/facilitators enable the formation of a supportive, nurturing and encouraging peer network, so students feel it is safe to 'go with the flow' despite initial doubts. This is in agreement with the observations that resistance disappears as individuals become more familiar with the method [15].

- That more emphasis is placed in the explanation of the role LEGO® pieces play as a 'language' and the importance of storytelling, and that examples of LSP outcomes are shared with the participants to build rapport between the exercise and the method as a "serious" and professional tool.
- That the access to LEGO® pieces is not restricted so that symbolic representations and metaphors are not led by the use of objects (e.g., ladders to go up/down, keys to open doors, skeletons in the wardrobe), but instead that plain bricks evoke metaphorical narratives.

4. Conclusions

The use of LEGO® to aid newly enrolled doctoral students explain their drivers and personal motivations to do a PhD was studied. The use of LEGO® incites the construction of metaphors and promotes storytelling. We found that a 'playful' frame of mind puts people at ease to share deeper level reflections, except for those who are new to the LEGO® construction play or those who reject its validity in a professional setting. The quantity and quality of metaphorical narratives were evaluated, and dominant metaphor types included visual, ontological and primary types, followed by the personification, orientational and absolute metaphors. Surprisingly, a large incidence of similes was also observed, attributed to a lack of engagement, language skills or cultural differences. We also used this exercise to successfully foster *cohortness* and an understanding of others' journeys and plans which increased a sense of belonging and satisfaction. What this study has not reported to date is the participants' reflections over the longer term.

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