Exploring content and language co-construction in CLIL with semantic waves

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Outline

(I)   "semantic profiles" & "semantic waves" (Maton, 2013)

(II) Semantic waves, unpacking and re-packing content in CLIL classrooms

(III) Analysis of semantic profiles of CLIL science lessons
→Excerpt 1: "Down escalators"
→Excerpt 2: "Semantic waves"
→Summary of useful strategies

(IV) Implications for CLIL practice and research

(I) Academic discourse in knowledge construction

- Academic literacies—what it takes to survive and succeed in school:

- '**Power words**': technical terms (e.g. keratin, deamination)

- '**Power grammar**': e.g. grammatical metaphor, wordings with high semantic density (e.g. "spontaneous deamination is the hydrolysis reaction of cytosine into uracil, releasing ammonia in the process".)

- '**Power composition**': e.g. "organising writing as rhetorical sandwich in which you tell the readers what you are going to write, write it and then tell them what you've written" (Martin, 2013, p.32)

  e.g. Factorial explanations are staged as "Phenomenon" → "Factors"

→Academic discourse deploys 'power words' and 'power grammar' to construe disciplinary knowledge (Martin, 2013)

- Legitimation Code Theory (LCT) (Maton, 2013): semantic gravity, semantic density, semantic profiles:

- "a sociological toolkit for the study of practice" (Maton, 2013, p.10)

1. **Semantic gravity (SG):** the degree to which meaning relates to its context; the stronger the SG (SG+), the more meaning is dependent on its context

→*strengthening* SG (SG↑), e.g. move from abstract or generalised ideas towards concrete cases;

→*weakening* SG (SG↓), e.g. move from concrete particulars of a specific context or case towards generalisations & abstractions (e.g. condensed into technical terms)

2. **Semantic density (SD):** the degree of condensation of meaning within socio-cultural practices (in the communities of the discipline); the stronger the SD (SD+), the more meaning is condensed within these practices

→*strengthening* SD (SD↑): e.g. when a large range of meanings (expressed, for example, through a series of lengthy descriptions) are condensed into socio-cultural practices (e.g. manifested as technical discourse)

→*weakening* semantic density (SD↓): e.g. when the meanings condensed within socio-cultural practices are explicitly unpacked and fleshed out

→ These concepts conceptualise one set of organising principles underlying knowledge-making practices (Maton, 2013)
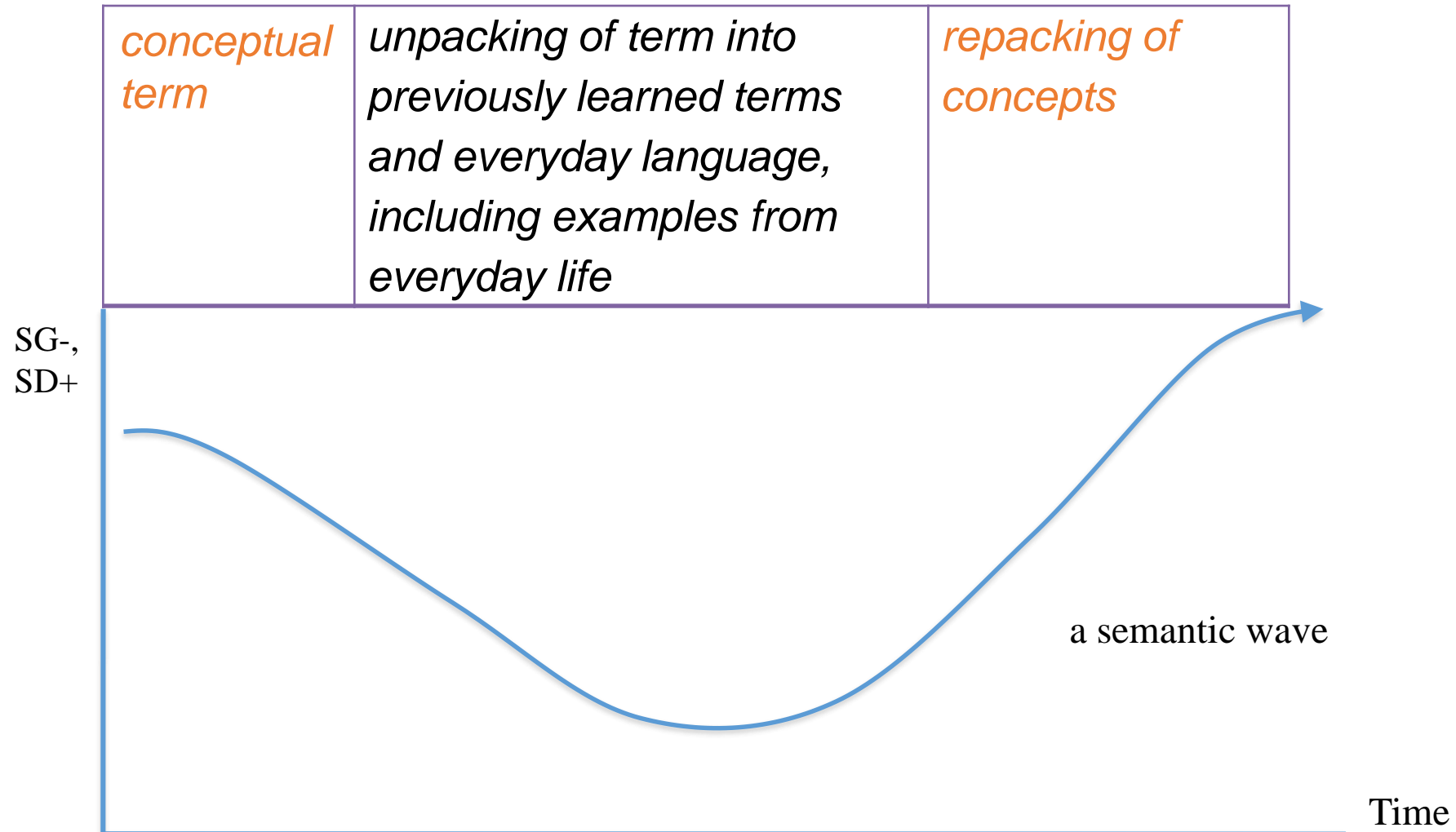
We can use "Semantic profiles" & "Semantic waves" to analyse pedagogical practices (Maton, 2013)

- "Conceptualizing processes of strengthening and weakening semantic gravity and semantic density (SG↑↓, SD↑↓) enables researchers to trace the semantic profile of practices over time" (Maton, 2013, p.12)

→ Can be used to analyse knowledge making/co-construction practices in lessons (e.g. an exchange, a phase/stage, a lesson, a unit of work)

"Semantic waves": model recurrent shifts between unpacking & repacking
→ "key to cumulative knowledge-building" (Maton, 2013, p.8)

conceptual term	*unpacking of term into previously learned terms and everyday language, including examples from everyday life*	*repacking of concepts*

SG-,
SD+

a semantic wave

Time

An example from a Year 11 Biology classroom: "Cilia" (Maton, 2013, p. 15)

Oral unpacking: everyday language; previously learned concepts; example from daily life

Teacher: Okay [student's name] what are the 'cilia'. What was it? No? [Student's name] do you know what cilia is? No? Someone must know what they are. . .
Student: Hairs
Student: The little hairs?
Teacher: The little hairs. And basically, they beat in an upward motion from inside your body out through to your nose. [Teacher is waving arms upwards]. So, they beat up and they take the pathogens away with them. And, guys, I don't know if I've ever told you this, but when you smoke cigarettes, the tar actually causes your cilia to, because it's so heavy, to drop, and so your cilia don't work properly after that because they're too heavy, they've dropped, so they can't beat the pathogens out of your body! So that's one reason that smoking's bad as well. Okay! Alright, write this down under description!

Repacking: Jotting notes on the board

cilia	Hair-like projections from cells lining the air passages	Move with a wavelike motion to move pathogens from the lungs until it can be swallowed into the acid of the stomach

However …

- "Semantic waves" are rarely observed in classrooms: teachers mainly do "unpacking" (downward shifts), without attempts to "repack" (upward shift) (Maton, 2013)

- Or: teachers mainly unpack and repack knowledge "orally", without guiding students through high-stakes writing (Martin, 2013)

SG-, SD+

High-stakes reading

High-stakes writing

Time

# (II) Using semantic profiles to analyse CLIL classroom practices

- What is CLIL?

- Content and language integrated learning:

'…an education approach in which various language-supportive methodologies are used which lead to dual-focused form of instruction where attention is given both to the language and the content' (Coyle et al., 2010, p.3)

→ **CLIL puts extra emphasis on the integration of *BOTH* content learning & language learning, often in the same lesson**

- "Language" involved in CLIL (Llinares et al., 2012):

- Usually teachers' & students' foreign/second language (L2) (e.g. English)

- Everyday conversational language (for classroom communication & interaction)

- Academic language/ Subject literacies (important for students to succeed in high-stakes assessment)

→Tremendous challenges for CLIL teachers & students

- "Incidental" language learning approach (or "*language bath*") is unlikely to be effective in CLIL

→ More explicit instruction & guidance

- "semantic profiles" can be used to analyse how CLIL teachers de-construct AND co-construct "content" & "L2 academic discourse"

→need to draw on more "unpacking" and "repacking" strategies,

→Students' L1 resources and everyday language & examples may be particularly useful

The rainbow diagram (Lin, 2012, p.93)
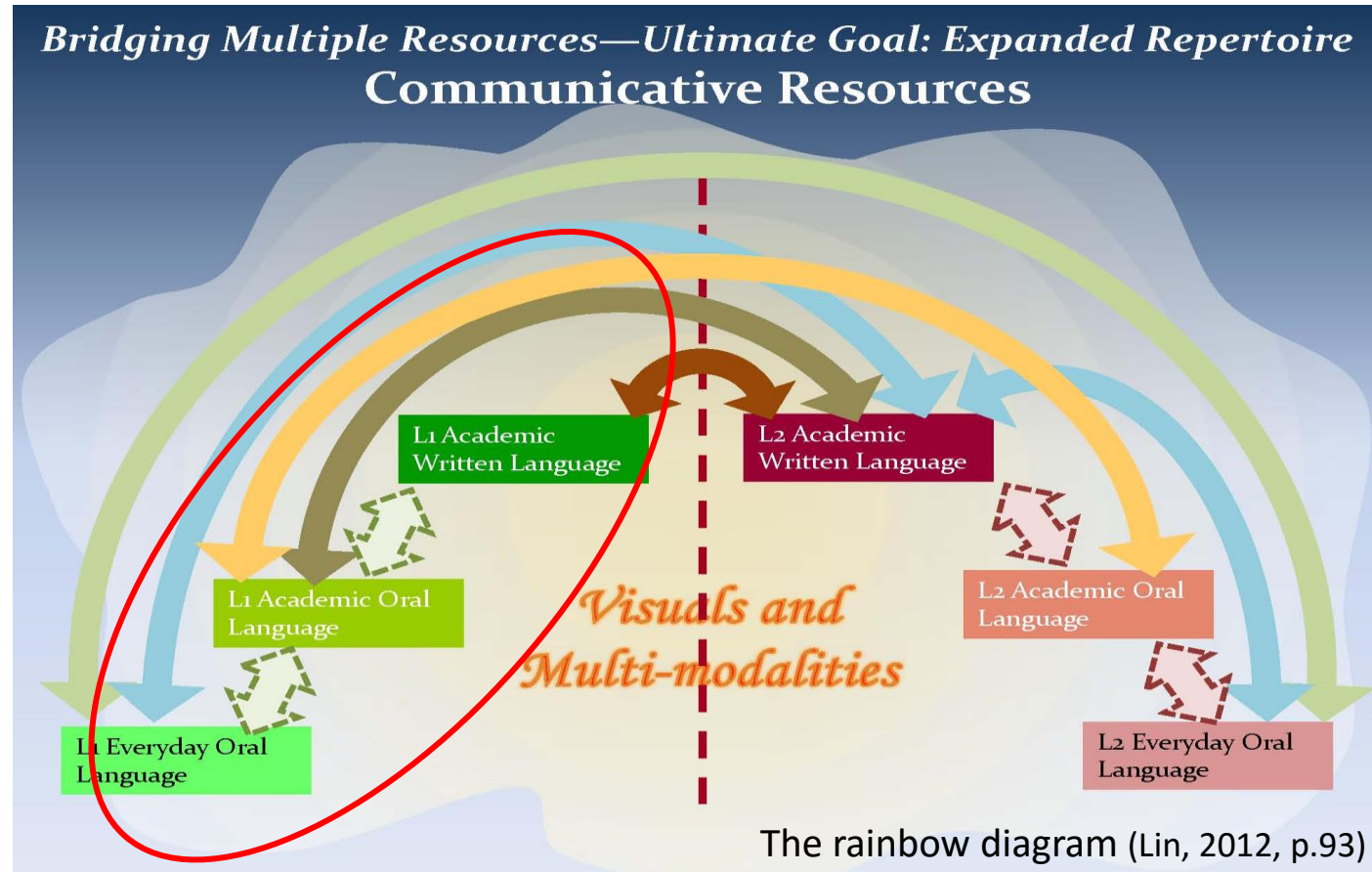
(III) Analysis of semantic profiles of CLIL science lessons

- Context: English-medium science lessons in Hong Kong (i.e. practicing some version of CLIL)

→Students learn English as L2, while learning some or all content subjects through English

- Naturalistic observations to examine classroom interaction patterns & teachers' pedagogical practices in CLIL lessons

Excerpt 1 (T1)

- First part [03:56 – 08:40] of a Grade 10 (15-16 years old) Biology lesson
- Topic of the unit: "Food substances"
- Topic of the excerpt: "Protein" (structure & functions of protein)
- Prior knowledge/teaching: Fats & Carbohydrates
- High-banding school; students had been learning most content subjects in English since Grade 7

T1: [T has just finished explaining the structure of proteins] … Well, why do we need protein? Why? (pause) Why? Why do we need protein?

S1: Body building

T1: Louder

S1: Body building

Decontextualised concept: "Protein is needed for body building"

T1: Yes, for body building. Okay? So which part of your body, okay, well, body building. [pause; writing on the blackboard] Can you tell me which parts of your body are made up of protein?

S2: Bones

T1: Well, okay. Part of bones, right? I would like to say bones, bones also contain a lot of minerals. Okay? So part of bones. Anything else?

S2: Hair (pause)

T1: Air?

S2: Hair.

T1: Hair, okay, yes. Hair. And _____?

S2: 手指甲 (*nails*)

T1: 手指甲 (*nails*). Okay, actually hair, the nail. Anything else? (pause) How about animals? Animals have _____?

T1 interacted with Ss to flesh out the concept with more specific examples or contexts

During the process, T introduced another technical term (SG-,SD+): "Keratin"

S3: Horn

T1: Horns, yes, horns. Actually they belong to the same class of proteins called keratin. 角，角，角，叫角質層呀 (*Horns, horns, horns, (they are) called keratin*). Okay? And also our skin, you know, skin. They all contain the same type of protein. So next time when you 食鹿茸 (*eat antlers*) [antlers as expressed in the term of Chinese medicine], you know, 鹿茸 (*antlers*), when you don't have the money to buy 鹿茸 (*antlers*), what can you do? (pause) You bite your nail. Okay? Just bite your nail. It's the same protein. Okay? [Ss laughed] (pause) So anything else?

T1 unpacked the term with L1 translation equivalents, examples & daily life examples

S4: Enzymes

T1: Yes?

S4: Enzymes

T1: Sorry? I can't hear.

Ss: Enzymes … enzymes

T1: Enzymes. Okay. We don't call it body building for enzymes because for body building, you mean building up your body structure. We want, I want something structural, structure.

S5: Muscles

T1: Muscles, exactly, muscles. So people who want to build their body, they actually have to take in extra protein, like kind of, er, like milk powder. 有無見過呀? (*Have you seen that?*) 嗰啲，嗰啲，食嗰啲補充劑. (*Those, those, eat those supplements.*) 有無呀? (*Have you?*) (…) (a student's name), you have the potential. [Ss laugh] Can you show us your muscles?

S6: 我無呀 (*I don't* (have any muscle)) (…)

T1: Yes. They have to take in extra protein supplement. See? This is what it means by body building. And I heard (a student's name) said something very important. Besides body building, they are also important in our, in our, well, functioning. It's extremely important in our body function because protein is needed for making enzymes. Remember? Okay? And enzyme is the, is the, well, (…) for all our, our meta, metabolism, for our metabolic reactions. Okay? So protein is very important for, well, body building and help our body functions. Okay? (pause) Okay? Or Let me show you a few pictures? I think probably some of your, some of your, you have seen these pictures earlier, right? In form three, I showed it to my form three students. Okay? It shows you what happen if you have good protein, well, good source of protein.

[Ss laughed]

T1 briefly repacked the concept with a summary and added the decontextulaised concept of "functioning"

Upward shift 2: Summarising the function of body building (for growth & repair)

Upward shift 3 & 4: Introducing the function of "providing energy" and its problem

Downward shift 3, 4 & 5: "Deamination", "Urea" & "Ammonia"

Upward shift 2: Summarising the concept

T1: (...) When you don't get enough protein, you become so thin. Okay? Because protein is important for body building, okay? So generally, for growth and repair. I forget one thing, you know, protein also gives energy, you know that? Okay? Carbo, very often we say carbohydrates and fats are for body, or for what? For energy. But in fact, protein is also a very important energy source. Okay? (pause) Well, one problem with protein is, we, our body doesn't store protein, it doesn't store it. When we have excess protein, we will break it down into amino acids. And then we can't store amino acids. And we have to break it down by a process called deamination. We will talk about it later, okay? That's we remove excess protein and we pass it out as urea. You know what's urea?

Ss: 尿 (urine)

T1: Urea, 尿素 (urea) And, and some as ammonia. Ammonia has a familiar smell at the toilet, right? Okay? Ammonia and urea ...

Upward shift 3 & 4: Decontextualised concepts of "energy source" & "problem of excessive protein"

T1 unpacked the abstract terms "deamination", "urea" & "ammonia" in different ways

Semantic profile of T1: "downward semantic shifts" or "down escalator"

→ from highly condensed and decontextualized ideas (SG−, SD+) towards simpler, more concrete understandings (SG+, SD−) i.e. repeated unpacking

→ Strategies adopted: examples/ everyday experience, visuals, everyday L2, everyday L1 & academic L1

→ However, with only very limited "repacking" (mainly oral summary of previous discussion)
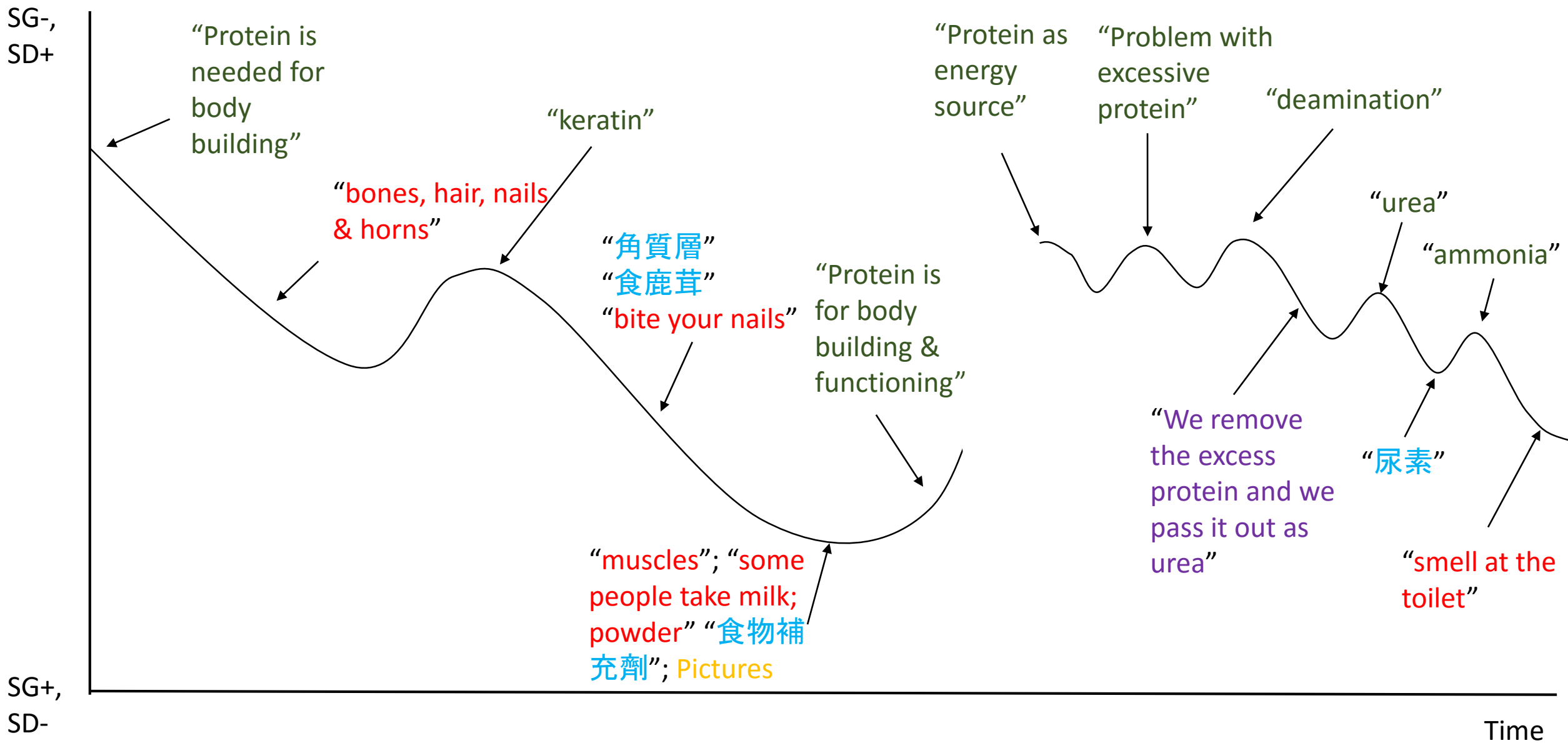
The semantic profile of excerpt 1

Excerpt 2 (T2)

- First part [01:30 – 27:52] of a Grade 7 (12-13 years old) Integrated Science lesson

- Topic of the unit: "Matter as particles"

- Topic of the lesson: "Brownian Motion"

~ "when larger particles are hit by smaller particles, the larger ones change the directions and move in a zigzag path"

- Prior knowledge/teaching: Characteristics of particles & the particles theory

- Mid-banding school; students had just started CLIL experience

T2: So, today, what we are going to do today is to learn about the Brownian motion. We have discussed the Brownian motion. Remember that, the apps that I used in your classroom?

S: Yeah

T2: Oh yes. Really?

S: Yes

T2: This one (*connecting the ipad to the projector*), remember that?

S: Yeah.

T2: So, what do you see now? What are they? They are balls?

S: Particles!

T2: Yes they are particles. That's right. Now if I, here, maybe they are some particles. Are they moving in a very fast speed?

S: No.

T2: No, they are slow, right? So if I increase the temperature, I am increasing the temperature, so what are the changes?

S: Faster!

T2: They move faster. Okay, let me increase the temperature. (pause) Now they are moving. So are they moving in a straight line or? In a circular path?

S: No ... circle

T2: In a circle? Or straight line?

Decontextualised & abstract concept: Brownian Motion

T2 used an apps to visualise the movement of particles, under normal condition and with increased temperature

T2: They will make a straight line. Okay. Now if I add some particles. They are blue in colour. So is there any difference between the blue colour balls and the purple balls? Compare. How about the size? Are they the same size?

S: No.

T2: No. They are different size. Which one is bigger?

S: Purple.

T2: Purple balls is bigger. Now I want all of you to observe, to see how the purple particles moving. What are their path? Is it the circular or straight line? Now still in a straight line? No, they are not moving in a straight line. In a circle? Yes?

S: No.

T2: No. So do you still remember our three choices. The first one straight line. Second, zigzag path. And then the third one in a circular path. So, zigzag path. What is the meaning of a zigzag path?

S: Z 字型 [The shape of the letter Z]

T2 continued to use the apps; also used L1 to unpack the term "zigzag path:

T2: Can you use a English letter to represent? Yes, it's like a 'z'. That's why it's called a zigzag. They are moving in a zigzag path. Why? Why they are not moving in a straight line, but a zigzag path? Observe how they are moving in a zigzag path. Initially they are moving in a straight line, right? Without the blue small particles, they are moving in a straight line, the purple one. But after adding the blue small particles, now the purple particles are moving in a zigzag path. Why? Give me a reason.

S: 撞. [*hit*]

T2: 撞. Hit? So which hit which?

S: The blue…

T2: The blue particles hit the purple particles. And then after the hitting, what happen to the purple particles?

S: Go to another side.

T2: Go to another side. It change the…? It change something. Something is changed.

S: Way. Direction.

T2: Yes, change the direction. That's why the purple particles are moving in a zigzag path. So this kind of motion, we call it Brownian motion, Brownian motion.

T2 interacted with the students & prompted them to think about the concept, using the example/ context illustrated by the apps & everyday L2

T2: ...Now refer to your textbook. You have observed the Brownian motion through my apps. Can anyone describe what is Brownian motion again? You have pieces of information. Someone do a summary for us. First one, they are moving in a zigzag path. And then second, I ask you. So someone gave me the answers. Someone gave me the reason why. Do you still remember that? Who tell me why they are moving in zigzag path?

S: Hit.

T2: Hit. So which one hit?

S: The blue...

T2: The blue particle hit the purple. So that is the smaller particles hit the larger particles. And then what happened to the larger particles? They change the...

S: Direction.

T2: Direction. Okay, so here are the key points for the Brownian motion. First, you observe that the bigger, the larger particles move in a zigzag path. And then why? Because the smaller particles will hit the larger particles. And then the larger particles will change the direction of motion. Rather than moving in a straight line, they are move in a zigzag path. Right? Like the English letter 'z'. Or you may say in Chinese, Z 字型. So this is Brownian motion.

T2 summarised & repacked the key points of Brownian motion; decontextualizing from "blue & purple articles" to "larger & smaller particles"

T2: Why the pen stop moving? Stop writing? You should writing down something now into your handout, your journal or your textbook. Hurry up. Otherwise, we don't have time for the experiment. We will have the experiment if you do well. Oh, I forgot the first one. What is the first point?

S: Zigzag path.

T2: Zigzag path. And then how about the second point?

S: Smaller particles.

T2: Smaller particles will hit…

S: Just hit.

T2: Just hit? The larger particles. And the last one is?

S: Change the direction.

T2: Change the direction. Okay, very good. Did you all copy down?

Ss: Yes.

T2 illustrated Brownian motion again, with decontextualized "larger & smaller particles"

T2: Yes, very good. Let's go back to your textbook. On page 149. Here are some descriptions of Brownian motion. So the first one, the first guy observed the Brownian motion is called. Here's the name, Robert Brown. So that's why the motion is named after him. We call it Brownian motion because the first one observed this kind of motion is called Brown. In a year of 1827. So what did he do? He observed some pollen grains. Something related to the flowers. You should put down the meaning on your handout. Remember we have the tables here. Yes, pollen grains. Okay, what happen to Brown. He observe that the pollen grains move in a zigzag path. Then he ask himself. Do you remember the steps of scientific investigation?

S: Asking question.

T2: Yes, asking question. So Brown ask a question. He observe that the pollen grains in water are moving in a zigzag path. So he ask himself a question. Why did the pollen grains move in a zigzag path? And then he have a suggested answer. What do we call the suggested answer in Science? Start with 'h' the word. Hypo_____?

S: Hypothesis.

T2: Hypothesis. That's right. So here is the hypothesis. The hypothesis is that the pollen grains is something large compared with water, right? 花粉是大過水. So pollen grains is larger than water. So pollen grains will hit the water particles. And then what will happen to the pollen grains? The third point. Change the…

S: Direction.

T2 contextualised Brownian motion with Brown's discovery process (the examples of pollen grains & water particles)

T2: Direction. That's right. Change the direction, okay? You can refer to page 151. Is it better? (adjusting the projector)

S: No. Can't see anything.

T2: You can't see anything. I agree with you. Maybe we just underline the word. And then I will draw it for you. Don't worry, okay? So what is the hypothesis is that the small particles will move in a random direction. And then they hit the large particles randomly. Do you still remember the meaning of random?

S: 隨機 [random]

T2: Yes, 隨機. It cause the larger particles to change the direction of motion frequently. That's why it move in a zigzag path. So here in this passage, smoke grains represent the large particles. How about the air particles? What is it represent? Large or small?

S: Small.

T2: Small. That's right. Air particles represent the small particles. And then smoke grains represent the large particles. So did you underline? And these sentence are the descriptions about the Brownian Motion. And here again the key points. So you may also memorize the key points here. Just the same, but it change the subject only. The Brownian Motion are of very small grains. It's caused by the water particles or air particles hitting the grains randomly from different direction. It appears again in the key points. So do you all now understand what is Brownian Motion? Maybe yes?

Ss: Yes.

T2 summarised Brownian motion again

T2 illustrated Brownian motion with another example "smoke grains & air particles"

T2: Now we have a practice. Don't close your textbook. Open your notes or handout to page 3. Page 3. In page 3, look at the question under Brownian Motion, the box. Imagine, you are going to observe the movement of some metal beans and some balls. So which one is lager? Beans or balls?

S: Beans…balls…

T2: Hah?

S: Balls.

T2: Balls should be larger than beans, I suppose. The metal beans is smaller, right? So how about the balls? It's bigger. Now when they are group together, what will happen to the balls which is larger than beans? What will happen to the balls? Describe, how would it be? The motion, the path. They will move in zigzag path. Yes, Brownian Motion again. So do you know how to write the description or the explanation of the Brownian Motion of the bigger ball? You should know how to write that down. Can you do it by yourself?

Ss: No.

T2 asked the students to do a writing practice to describe Brownian motion in "academic language"

T2: No? So maybe we do it together. Now first of all, the metal beans should be moving according to the particle theory. First one, you have to describe, here, the direction of the metal beans' move. So what is the direction?

S: 方向 *[Direction]*

T2: Yes, so what is the direction of the metal beans motion? Random. So we may say in random, in random direction. Can you use a simple word to represent random?

S: All.

T2: Yes, very good. In all directions. And then what happen when they meet the ball? They will ____? Forget already? Small beans, what would happen?

S: Hit the

T2: Yes, they will hit the ball. They hit the ball randomly and then, so the second sentence, you may refer to what's the interaction between the balls and the beans. They will hit the balls randomly from, which directions? Different directions, yes. And then, so what is result of the hitting? The hit may cause the balls to change its _____?

S: Direction.

T2: Direction. So the ball now are moving in, what kind of path? The zig _____?

S: Zigzag.

As Ss didn't know how to do it, T2 "co-constructed" the few sentences together with the Ss, with a sentence-by-sentence guide

T2: Zigzag path. (a student's name), can you follow us? Yes. Did you write down anything? We use some examples to help you how to write down the description about the Brownian Motion. First of all, we use the balls of different colours. Remember the blue particle and the purple. And then we do it again using the pollen grains and water. Now we just done about the metal beans and the balls. And then finally, what we require to do is that you have to write down the description about the Brownian Motion by using small particles and large particles. So how can you do that? You may refer to the passage above. You may use this sentence structure again. But are you going to use the words metal beans and the balls again?

S: No.

T2: No. So what are going to replace these two words? Smaller particles and…

S: Larger particles.

T2: Larger particles. So which one is smaller particles? Mental beans. So which one is larger particles?

S: Balls.

T2: The balls, okay. So can you rewrite the sentence again and then fill in the blanks below the word 'Brownian Motion'. Do you know what to do? 重寫上面的段落，但我們用什麼字？ [*Rewrite the above paragraph. But which words should we use?*]

S: Smaller…

T2: Smaller particles and larger particles, okay? So you will have two minutes. After two minutes, I will ask someone to read them out.

T2 gave some instruction for Ss to do independent construction (i.e. repacking)

A similar apps

BrownianMotion ♥ ⋮

Reset | Play

Temperature change → Heat | Cool
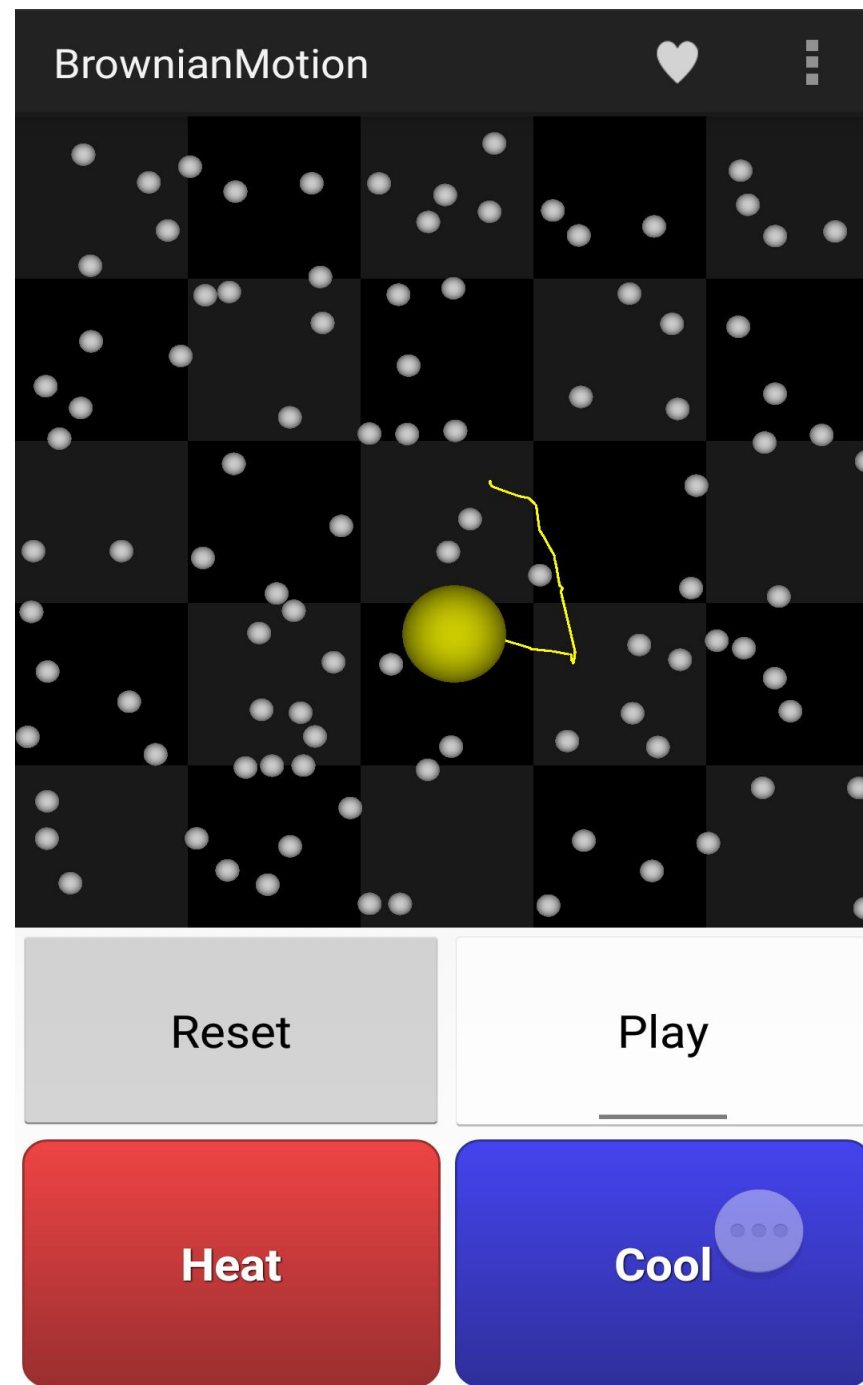
The handout & practice

Brownian motion (Book 1B, p.149)

Demonstration:

Tasks:

    1. Observe the movement of the smoke particles. (the directions of movement)

Explain what you see:

The metal beans move in _____.

They _____ the foam ball randomly from

_____. The hits cause

the foam ball change its _____

_____. So the foam balls move in

_____.

Guiding questions:

1.   Describe the direction of the metal beans move

2.   What is the interaction between metal beans and foam ball

3.   How do the foam balls move?

The Brownian motion:

_____

_____

_____

Language scaffolds

Independent construction

Semantic profiles of T2: some form of "semantic waves"

→ with repeated unpacking & repacking , both in spoken & written form

→Strategies adopted for unpacking: online apps/ animation; everyday life examples, everyday L2 & L1

→Strategies adopted for repacking: oral summary; guided & repeated writing practices (concrete → abstract/ contextualised to decontextualised); repetition with variation; joint-construction
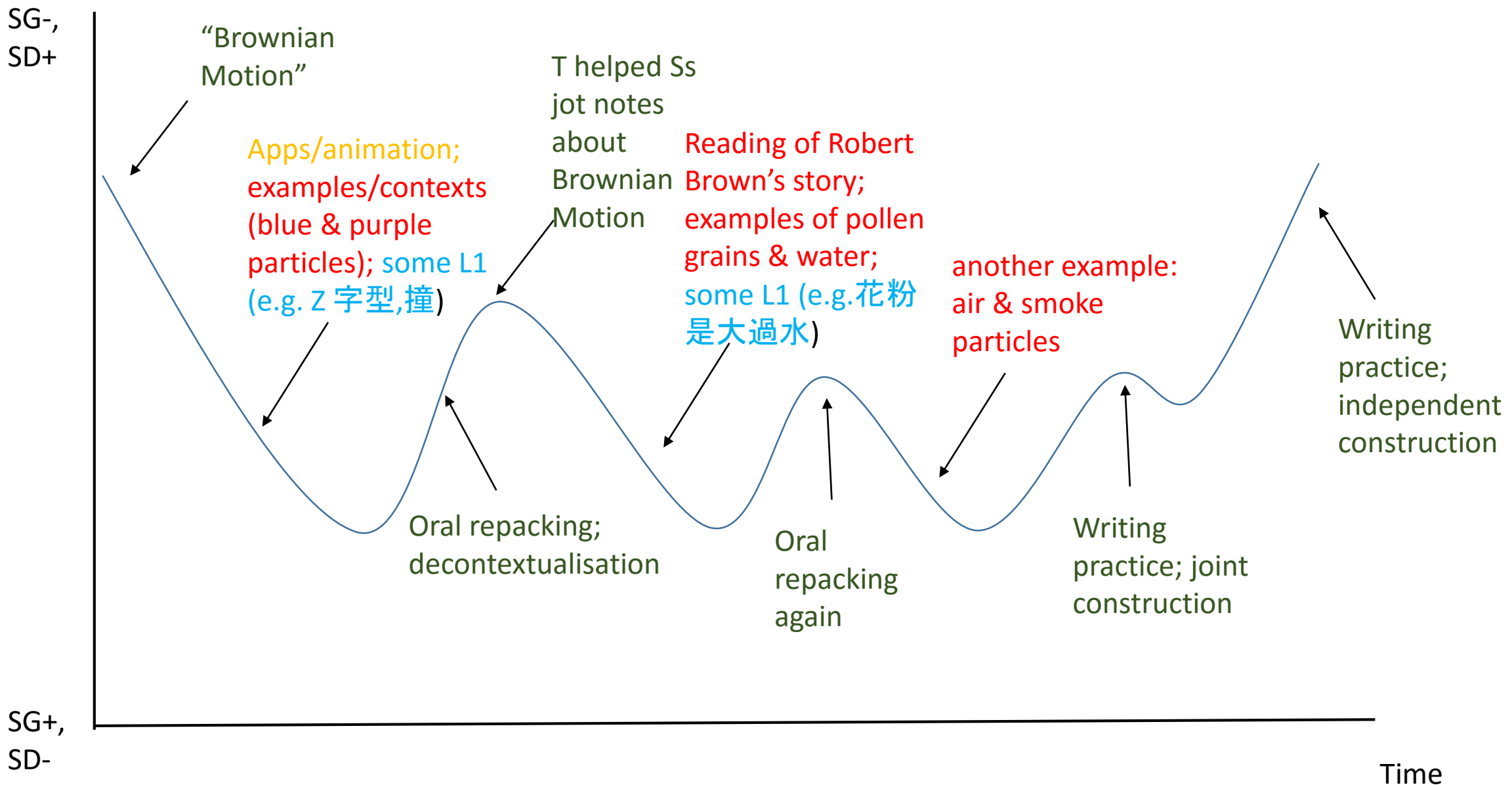
The semantic profile of excerpt 1

(IV) Implications for CLIL Practice & Research

- Application of semantic profiles to analyse the deconstruction & co-construction processes of both content and language in CLIL lessons

- The use of L1, L2 everyday registers and multimodalities in the unfolding dialogue (IRF) in the teacher's delivery of content; not just in unpacking (+SG, -SD) but also in re-packing (-SG, +SD); i.e., analysing translanguaging practices in conjunction with semantic profiles (e.g. how can translanguaging facilitate re-packing as well?)

- CLIL teacher development will benefit from:

- using semantic waves as a meta-language and visualization tool to engage CLIL teachers in critical reflection on CLIL classroom strategies