

Notes on Reading for GMAT Questions

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1. Introduction

This is a messy first draft of thoughts on reading for critical reasoning and comprehension questions, especially for GMAT, and commentary, including on my previous writing for supplementing my teaching. In its current state this draft is by no means intended to be distributed at all; I am adding this to the website just in case. I was teaching this recently and I kept away anything and everything I knew about reading research and simply included all that was my own experience, intuition and knowledge about reading. Here and there I did say it was about milliseconds (N-400 EEG signals) and all but that is neither necessary nor relatively substantial in quantity, besides the fact that I have not been conducting state-of-the-art reading experiments, consumer research or the like.

The present work contains clearly-marked AI Chats included as-is or edited; *nota bene* AI-generated content needs to be verified and this adds to one's work therefore making it much more convenient not to use AI for such tasks (there is so much research out there confirming the same). Critical Reasoning and Reading Comprehension questions are from the Official Guide (2023-4). Refer to GMAT Official Guide (Focus Edition) 2023-24.

2. Note-taking

Please note that I have been doing this for quite a long time and so the way I take notes and the way you take notes will be very different. Further, what occurs to you is unique to you and it may be that the same thing may not occur to you at a different point of time.

1. Read to ignore. For instance, in the passage on Product Performance Risk, reduce the line-long description to just ‘risk’. Ignore definitions, examples, lists etc. Ignore everything that is not contributing to the argument (X causes Y, B explains A, C and D conflict etc.)
2. Make an outline/structure of the passage. That is, write the argument.
3. Reduce to logical form. That is, find the relationships.

4. Focus on information (usually verbs) that moves the passage further; it can be a narrative.

For instance, in the passage “Jacob Burckhardt’s view that Renaissance” the only useful verbs here are those that tell me about the various individuals or groups that write in different ways about the topic—women’s (in)equality. Ensure you paraphrase in a reductionist fashion to extract the core idea in any part of a text (‘risk’ above, ‘generalising’ causing ‘better reaction to new stimuli’ in the neuroscientist passage options etc.).

5. Visual stretches of the passage help you locate look-up information, which is termed under ‘scan reading’. Now, as you go through the passage, the brain probably registers at what point in the stretch which information is located. That is to do with memory and you cannot depend on it. Among other things, this is why you have line numbers. Equally importantly, thinking of the spatial allocation in terms of, for instance, lists, logical elements etc. helps: think of [memory blocks](#) and [tree map](#) for the first and of antecedent-consequent, conclusion, contradiction etc. for the second. Lists of examples can be represented by: H(s) Socrates is human.; for all quantifier, existential quantifier etc. But one does not need that (it says in the official guide that no specialist knowledge is needed.)

6. Read for the argument. Why has the author written the passage? Or, why does the passage exist? When I say this, I mean several things and perhaps not surprisingly, it is inseparably connected with the structure of the passage. What is the purpose of the author (by which, I mean the person or team or AI that designed the question, the examiner etc.)? *To what end? So What?* What is the meta-text? [RECURSION](#): text about text, thinking about thinking etc. [Inception](#) is too clichéd an example. What is the metalanguage if it is there? Everything that comments on language is metalanguage—this also gives you the author’s attitude. To flesh it out (note again the [ANALOGY](#) continuing—‘skeleton’ of [Alaska passage](#)): if you have a rhetorical flourish on a GMAT passage, which you won’t have because it wastes space (examples of rhetorical flourishes are plenty in Victorian novels in general and Dickens in particular), you need to note that this can be about the author’s attitude to the communication/signal (an argument, a story, a report etc. that the passage conveys) or a part thereof. In the signal **ANALOGY**, this rhetorical flourish is a noise component. If you care to read: Greenblatt’s treatment of Hamlet Sr. Ghost’s communication to Hamlet is a good illustration.

What is the main idea? At school James and Lily’s son fought Evil over so many years and won. [That is the main idea of the novels](#). Let’s sell the most wonderful product of all, [or what you will](#). “Eleven percent”: why is this not efficient? Let’s fix it by doing some pilot tests first for which the plans are... Remember that questions involving mathematics have to be approached in the

particular way maths questions are attempted: the question on percentage of error due to airline error has to be thought of in terms of fractions to spend the least amount of time possible solving it. The research is inconclusive (“Historians remain divided...”). Philosophers have paraphrases of previous philosophers in new combinations of concepts (Distressed by his own personal tragedies...Cicero). How is the argument structured? Mark use of space as well as logical structure (which is more abstract).

Example:

He has been teaching this subject for so many years. (ia) Therefore, he must be very good at the subject. (ib)

He must be very good at this subject. (iia) He has been teaching it for so many years. (iib)

Note: both of the sentences (very short arguments) serve to express the same **causal relationship**. The second one does not have a marker (‘therefore’) that establishes this causal relationship and it does not have to have one—that is a characteristic of the English language.

A Working Logical Representation

(ia) is a **fact**, a **proposition** we accept as true instead of questioning its truth, to be classed **antecedent/cause/causans**. (ib) is **consequent/effect/causatum**: the **opinion** (*doxa*) that ‘he must be very good at the subject.’

There’s no need nor time to go further than that on the GMAT. In fact, I could write the same thing as follows.

The author of the monograph titled “*Cicero’s ailing emotions: A Stoic’s paradoxical pain as the exegete AI translates*” denounces the machine’s ability to ‘think’ in his lectures spanning the last five years. Dr. Sheppard, a renowned scholar on philosophy and machine understanding, presents his doubts as to the inevitable approach of the singularity—a veritable second coming—by citing Moore’s law for transistors. While whether the scholar’s erudite argument sustains the test of time is for futurity to tell, there is little question as to his refined ability to impart knowledge and deliver on foundational research. See also <https://thelanguagefellow.com/post/66>

Assume that the **context** is appropriate: there are people who can indeed have such a conversation. Would the author of this passage agree with the following? “He has been teaching this subject for so many years. Therefore, he must be very good at the subject.”

If you are keen on an ‘algorithmic’ way of doing this:

For every paragraph (CR or RC):

1. Identify the ‘topic sentence’: main thought, main idea, ... CLAIM/HYPOTHESIS, ...

usually at the start--but it can be anywhere in the paragraph, which is one way a passage can be made difficult.

2. Identify any minor claims on which the argument depends
3. Check that the remnant is support for one or more of the PREMISES

An argument (paragraph) may be thought of as a set of PREMISES (statement) connected in a hierarchy of directed graphs and trees. The idea must have been there for decades and decades, so let us not wonder about it: “There is nothing new under the sun.” Ecclesiastes (1:9).

Incidentally, this is an example of **appeal to authority**. One might argue that LLMs were not there but to this another might counter-argue that the thought of LLMs was there.

The problems:

1. The main claim/root node is flawed--which you can find by looking at the language use (extreme language is one clue, a toy sentence being, *It is absolutely **not possible** for an LLM to think the way humans ‘think’*. (i) Note that ‘drastically’ in the airline error passage is a false friend: the heuristic does not apply and this is a good reminder of not blindly depending on heuristics and ‘algorithmic’ ways.
2. One of the minor premisses or leafs in the tree is flawed.
 1. The evidence turns weak when presented with some counter-evidence or something that represents an exception, a disruption etc. For instance: suddenly, students who were scoring in the range 50% to 60% have started scoring 85% to 90 %. What explains this?
3. Caveat: avoid ideas that presume questionable ethics, e.g., do not question authority and facts (see above: “He has been teaching this subject for so many years.”). Again, I am saying not that it is not possible that there were irregularities but that the chances are thin. Compare with the other options when in doubt.
4. “All other things being equal” cf. the Latin phrase “*ceteris paribus*” in the domain of philosophy, solving equations etc.
5. Don't assume foul play (see point 3).

3. Types of RC passages on the GMAT

Exercise: Come up with your own Example column.

Concept	Example
1. Recognise stated ideas	
2. Find a passage's overall theme or point	The point of the Rain Forest passage is to list relationships between dependent variables and independent variables.
3. Find a specific detail	What did Tucci & Talaga discover about the probable cause of the increase in customer engagement for higher-priced restaurants?
4. Summarize a set of statements	Alaska faces an urgent need to address its economic dependence solely on oil and gas, its internal migrations and the need to conserve natural resources to preserve Inuit native culture.
5. Tell if an idea is stated or implied	Is it stated in the passage about conodonts that they were found to be the more ancient of the organism discussed?
6. Tell what a word or phrase means in CONTEXT	In the CONTEXT of the passage on municipal corporations above (AI-generated passage), what does 'zoning laws' mean?
7.	
8. Analyse reasoning structure	
9. Tell what argument technique someone uses	'Argument from/by example' is one technique. Because SMEs have been known to benefit from leveraging AI for clerical data-entry tasks as reported in FICCI Report on SMEs, Kasturi & Sons should implement this strategy for its logistics department to cut costs.
10.	
11. Tell a statement's role in a passage	'Roles' can be 'antecedent' and 'consequent' as seen in Tucci and Talaga passage.
12.	
13. Apply ideas in new CONTEXTs	
14. Decide which new situation is most like one in the passage	Transfer learning is one example.
15. Tell which new action would follow or break a rule in the passage	If evidence is discovered that beyond the archaeological remains excavated were structures that belonged to another culture, the civilisation in this geographic region would be different.
16. Decide which new example would best illustrate an idea in the passage	In error analysis, if I can infer that an LLM produced a hallucinated citation, somehow mixing up attributions, can I infer that a human probably made the same type of error.
17.	
18. Infer	
19. Decide which conclusion a passage most strongly supports	Can I conclude from the passage about Alaska that the US government is falling short of its commitment to Sustainable Goals when it comes particularly to its Arctic state?
20. Tell what follows logically from information given	He has been teaching this subject for so many years. Therefore, he must have learnt something about the subject.
21. Decide what a stated opinion implies	He has been teaching this subject for so many years. Therefore, he must have learnt something about the subject. However, I tend not to take it on its face-value without having my first-hand experience of this.
22. The above implies that the author will probably book a lesson with the teacher to test the teacher.	
23. Recognize an author's attitude from word choices in a passage	He said, "The tea tasted so good, Sir." The speaker was the addressee's student.
24. What does "so good" tell us about the speaker's attitude? Can the speaker be Tom Riddle in conversation with Professor Slughorn? Or, can it be Harry speaking with Professor Lockhart?	
25. Can I conclude here that CONTEXT decides all of this?	
26.	
27. Identify unstated assumptions	
28. Find an assumption an argument depends on	If the retina of a fly receives excessive light, a specially designed mechanism triggers an eyelid to protect it. Therefore, if I subjected the retina to this much amount of white light beyond the threshold, I will observe this phenomenon. However, the result does not turn out as expected.
29. The experimenter's assumption	the wavelengths I am using are the wavelengths that trigger the change.

30. Find an assumption that makes an argument's conclusion follow logically	An LLM generates a response revealing prohibited information in response to a prompt. It was concluded that the guardrails did not cover the particular element or elements the prompt contained.
31. The writer's assumption	The guardrails were effective for prompts that did not contain these new elements.
32. Tell what must happen for a plan to succeed	Alaska's native culture will be preserved from the recommendations if and only if environment conservation efforts lead to the natives' not migrating to urban areas or to the US.
33. Evaluate hypotheses	
34. Decide what would most help explain why a plan failed	What explains students suddenly starting to score in the band 80% to 95% from 50% to 60%?
35. Decide what most likely caused an observed effect	The man has never been known to have missed a single class. He missed it on a particular day.
36. It must have been physically impossible for him to attend that day, assuming that there was no possibility of attending the class online.	
37. Explain why a factor didn't cause its usual effect	The friends joked about a psychological truism:
38. My dog did not react to my showing him the stick while he usually does. Explanation	Pavlov missed a some crucial life lessons.
39. Decide which principle resolves a conflict between two opinions	There is a race condition in a variation on the Round Robin algorithm; the ranking, indexed separately, of the incoming HTTP requests resolve the deadlock.
40. Exercise	find the flaw if there is one in this one—Can there be such a variation on the Round Robin algorithm?
41. Strengthen or weaken reasoning	
42. Tell which discovery would cast the most doubt on an argument's reasoning	The CXO's allegations regarding QA practices was bolstered after the discovery of a trail of irregularities over the last 5 years, not just the 2 years under consideration.
43. Tell what added evidence would best support a causal explanation	The electronic noise had a component that had its so far undetected source in a residual wireless interference. The noise, therefore, needed attenuation on different Fourier components.
44. Identify reasoning flaws	
45. Decide which observation points to a reasoning flaw	The mix up in the antecedent and consequent in one of the choices for Tucci & Talaga's report on restaurants.
46. Tell which criticism an argument is most vulnerable to	If evidence is discovered that beyond the archaeological remains excavated were structures that belonged to another culture, the civilisation in this geographic region would be different.
47. Criticism	one cannot retroactively operate on reversing civilizational changes to disrupt the status quo.
48. Identify points of disagreement	
49. Find the main implied point of disagreement in a dialogue between two people	
50. Speaker 1	The government must provide a more stable career after such a short-term commission.
51. Speaker 2	The government needs to account for fiscal constraints over the next century.
52. Speaker 1	To achieve this, the government cannot risk an individual's lifetime prospects.
53. Speaker 2	Individuals need to decide whether individuals matter more than what is at stakes.
54. Point of disagreement	the individual does not deserve risking lifetime prospects for short-term commissions.
55. Solve a practical problem	
56. Find a way of sampling a population accurately despite an obstacle	See sampling methods. But don't take this literally—there can be other practical problems, I am sure.

4. Types of CR passages on the GMAT

Exercise: Prepare a table of CR passages with columns such as explanation in your own words. The following is an extract from <https://thelanguagefellow.com/cr.xlsx>

No.	Start
1	A certain cultivated herb is one of a group of closely related plants
2	A company has developed a new sensing device
3	A company that manufactures plastic products
4	A large number of customers will pay at least the fair market value for a cup of coffee
5	A major network news organization experienced a drop in the week following the report
6	A marine biologist argues that transmission of sea lice from farm salmon to wild salmon is unlikely in the Broughton Archipelago, British Columbia, citing numerous studies
7	A moderately large city is redesigning its central downtown aread and is considering a plan that would reduce the number of lanes for automobiles and increase those for bicycles and pedestrians.
8	A new law gives ownership of patents ... to univeiversities ...
9	A physically active lifestyle
10	A product that represents a clear technological advance over competing products
11	A prominent investor who holds a large stake in the Burton Tool Company
12	A provincial government plans to raise the gasoline tax
13	A study compared a sample of Swedish people older than 74 who needed in-home assistance
14	A study of ticket sales at a summer theater festival
15	A successful coffee stand that serves the workers in a large office building plans to increase its profits by adding oatmeal
16	A year ago, Dietz Foods
17	According to a study, after a week of high-altitude living, twenty men had slimmed down.
18	According to the last pre-election poll in Whippleton
19	Ace Repairs ends up having to redo a significant number of the complex repair
20	Advertizing by mail has become much less effective

Keywords

ANALOGY: air is to humans as water is to fish. Cf. old GRE format.

ANTECEDENT: time order of things versus logical order of things.

ASSUMPTION: You would not read this page if you were not interested, mandated, persuaded, influenced etc. An assumption can be necessary but it does not have to be sufficient.

CONSEQUENT: If p then q . q is the consequent.

CONTEXT: This is best exemplified by use of words: I can use a word to mean one thing in a given instance, something totally different in another and multiple things in a third.

CONCLUDE: 'Conclusion' as narrower than 'things that conclude'.

DISCOURSE: extended communication.

LOGICALLY CONSISTENT: the relations between premises/propositions/statements are valid (if it rains in a given area, the area will have water on it) and are preserved.

METALANGUAGE: any criticism from literary journals; e.g., *Dickens' Language*, Andre Deutsch.

METATEXT: The term(s) itself is not important. Focus on the concepts of 'reading between the lines' etc.

PARAPHRASE: rewording.

SUBTEXT: the RC passage on environmentalists called out for not framing ecological services in economic terms.

ISSUE: what is the question that a passage decides? Note that I have also been saying this critical reasoning arguments.

SHIFT: note how a passage moves from, e.g., listing some findings to detailing a particular one.

Reading a passage is filling out a matrix

All the cells must point to the same truth conditions if we assume a truth-conditional framework. The cells will not point to them in isolation. Modelling this mathematically involves operations for cancelling out everything that is not strictly in the passage, including unstated assumptions, inferences etc.

Matrix	
Acting on the recommendation of a British government committee investigating the high incidence in white lead factories of illness among employees, most of whom were women, the Home Secretary proposed in 1895 that Parliament enact legislation that would prohibit women from holding most jobs in white lead factories. Although the Women's Industrial Defence Committee (WIDC), formed in 1892 in response to earlier legislative attempts to restrict women's labor, did not discount the white lead trade's potential health dangers, it opposed the proposal, viewing it as yet another instance of limiting women's work opportunities. Also opposing the proposal was the Society for Promoting the Employment of Women (SPEW), which attempted to challenge it by investigating the causes of illness in white lead factories. SPEW contended, and WIDC concurred, that controllable conditions in such factories were responsible for the development of lead poisoning. SPEW provided convincing evidence that lead poisoning could be avoided if workers were careful and clean and if already extant workplace safety regulations were stringently enforced. However, the Women's Trade Union League (WTUL), which had ceased in the late 1880s to oppose restrictions on women's labor, supported the eventually enacted proposal, in part because safety regulations were generally not being enforced in white lead factories, where there were no unions (and little prospect of any) to pressure employers to comply with safety regulations.	recommendation (cf. Alaska passage) action on recommendation for issue lead CAUSES health hazards FOR WOMEN Stakeholder 1 Note the use of 'discount'--priming effects in psychology etc. WIDC opposed the legislation what WIDC made/thought of it the brain notes (if it does not, train it to note) the exact structure as for WIDC above causes of illness: Every time there's an opportunity to take down a logical relation, take it down. SPEW and WIDC agree on this SPECIFIC POINT. The same structure again--this may be deliberate, may be not for the purposes of the question-making on the exam. Train your brain to pick this up. Sum: In this MULTILATERAL thing three STAKEHOLDERS support/oppose a bill for various reasons. Again, WRITE

	SOMETHING–REWRITING IS BETTER THAN WRITING NOTHING.
Questions 1. What is a one-line summary of the passage? 2. Who are the stakeholders in the passage? 3. Does the author express opinions on the CONTENT in the passage? 4. What are some instances resulting from scan reading? 5. What is the ISSUE that the bill discusses?	Answers Incidentally, this is from 2017–shoutout/callout to those... Day 1; here, WIDC, SPEW and WTUL one side and Home Secretart/British Govt the other etc. Not a single thing to write here. the timeline. Should women be allowed to work in Pb factories (use lead if Pb is troublesome).

Matrix	
Findings from several studies on corporate mergers and acquisitions during the 1970s and 1980s raise questions about why firms initiate and consummate such transactions. One study showed, for example, that acquiring firms were on average unable to maintain acquired firms' pre-merger levels of profitability. A second study concluded that post-acquisition gains to most acquiring firms were not adequate to cover the premiums paid to obtain acquired firms. A third demonstrated that, following the announcement of a prospective merger, the stock of the prospective acquiring firm tends to increase in value much less than does that of the firm for which it bids. Yet mergers and acquisitions remain common, and bidders continue to assert that their objectives are economic ones. Acquisitions may well have the desirable effect of channeling a nation's resources efficiently from less to more efficient sectors of its economy, but the individual executives arranging these deals must see them as advancing either their own or their companies' private economic interests. It seems that factors having little to do with corporate economic interests explain acquisitions. These factors may include the incentive compensation of executives, lack of monitoring by boards of directors, and managerial error in estimating the value of firms targeted for acquisition. Alternatively, the acquisition acts of bidders may derive from modeling: a manager does what other managers do.	So many passages on findings seen and will be seen. Cf. list of findings of various studies Tawahaka above. Findings for ISSUE: why mergers and acq. are executed by co's? 'One study', 'Second study', 'Third study'--I already know what this is about and so I will save space. Here, what's new is the use of 'for example' much the same way as MISNOMERS are used: the passage lists 3 studies and so this can't be just there to give me an example and it is not. What the examiners are doing here is that attack on heuristics kids preparing for exams prepare. study 1: acq. bad because post-acq. profitability levels unviable. study 2: acq. bad because expenses not met. study 3: acquired's stocks inc. value than acquirer's stocks. SHIFT in TOPIC: acq. are of national importance. However, REALITY: acq. benefit co's and its executives. Factors that explain acq. use of words in context: in the present context what does "modeling" mean. Sum: M&A national importance--co's & exec's pockets--findings w/ evidence for adverse effects--factors listed & alternative factors listed.
Questions	Answers

Matrix	
Among the myths taken as fact by the environmental managers of most corporations is the belief that environmental regulations affect all competitors in a given industry uniformly. In reality, regulatory costs—and therefore compliance—fall unevenly, economically disadvantaging some companies and benefiting others. For example, a plant situated near a number of larger noncompliant competitors is less likely to attract the attention of local regulators than is an isolated plant, and less attention means lower costs. Additionally, large plants can spread compliance costs such as waste treatment across a larger revenue base; on the other hand, some smaller plants may not even be subject to certain provisions such as permit or reporting requirements by virtue of their size. Finally, older production technologies often continue to generate toxic wastes that were not regulated when the technology was first adopted. New regulations have imposed extensive compliance costs on companies still using older industrial coal-fired burners that generate high sulfur dioxide and nitrogen oxide outputs, for example, whereas new facilities generally avoid processes that would create such waste products. By realizing that they have discretion and that not all industries are affected equally by environmental regulation, environmental managers can help their companies to achieve a competitive edge by anticipating regulatory pressure and exploring all possibilities for addressing how changing regulations will affect their companies specifically.	Summary: Env Managers get something wrong—the compliance thing is not even/uniform—but depends on several factors: plant location, size of plants/revenue base and production tech...further DETAILS...—advice for env. managers.
Questions	Answers

Matrix	
Two works published in 1984 demonstrate contrasting approaches to writing the history of United States women. Buel and Buel's biography of Mary Fish (1736–1818) makes little effort to place her story in the context of recent historiography on women. Lebsock, meanwhile, attempts not only to write the history of women in one southern community, but also to redirect two decades of historiographical debate as to whether women gained or lost status in the nineteenth century as compared with the eighteenth century. Although both books offer the reader the opportunity to assess this controversy regarding women's status, only Lebsock's deals with it directly. She examines several different aspects of women's status, helping to refine and resolve the issues. She concludes that while women gained autonomy in some areas, especially in the private sphere, they lost it in many aspects of the economic sphere. More importantly, she shows that the debate itself depends on frame of reference: in many respects, women lost power in relation to men, for example, as certain jobs (delivering babies, supervising schools) were taken over by men. Yet women also gained power in comparison with their previous status, owning a higher proportion of real estate, for example. In contrast, Buel and Buel's biography provides ample raw material for questioning the myth, fostered by some historians, of a colonial golden age in the eighteenth century but does not give the reader much guidance in analyzing the controversy over women's status.	Summary: ISSUE: B&B vs Lebsock OPERATOR current historiographic trends. B&B history book vs Lebsock history book Lots of what Lebsock does. Comparatively little of what B&B does. The authors certainly cover different grounds, signalled by words 'contrasting approaches', 'in contrast', 'make little effort...context of recent histo. etc.'
Questions	Answers

Critical Reasoning from the archive

Editing this on 08 July 2026—yet to decide on what scheme to use; until then, underline and square brackets.

Last updated: Tuesday, 28 March 2023

What is all this about?

28 March 2023

07 March 2023

17 February 2023

28 January 2023

13 January 2023

03 December 2022

December 18, 2022

November 04, 2022

September 30, 2022

Somewhere in September 2022

What is this all about?

NB: I will keep updating this document as and when appropriate. I hope this does give you a good idea of the subject matter. Remember, the point is to think and thinking one of the things that you will have to do for yourself (unless you want someone else to write your exam, obviously). I don't know about you, but I do my own thinking, thank you very much [‘rhetorical flourish’ cf. Harry Potter*].*

I have been telling people that they already know these things [cf. reduced LF, math repr, paraphrasing, systems, e.g., biological, ecological, ...] and that I am no magician. People, when they are over 20, have enough experience to relate situations with one another [says who?]. That's what this is about, only if one would take the pains to imagine reasonably.

when does a child learn to make sentences? 3 years

underspecification think about ambiguity

The thing you must do first is ask yourself who the parties [stakeholders] are or what the sides are [relative to the issue]. If there are no clear-cut sides, for example, it is most probably the case that the author is involved in the **argument** [start with Derrida and Barthes from literary theory, for example]. That is the first, and one of the most important things, that you have to figure out when working with these (toy) **arguments**—I call them toy arguments because I *can* call them toy **arguments** [in fiction, even you can]. That said, these very toy **arguments** will get you marks on the exam [so don't toy with them].

There are two things that they test: language and logic [as I have been saying]. They are not testing specialised knowledge, to be sure [if they were, it would be Subject Test etc.]. So, if you read newspapers and stuff like that [UPSC], it is help more than I can emphasise this.

March 28, 2023, The Latest

Okay. So I have been talking about the new technology that has 'taken the world by storm', as some might put it. But all of this falls into place if you just realise that things are built on top of each other. The latest **analogies** [**mechanical and electrical and Maxwell's equations**] I have given include:

1. Finite state **automaton** (the **argument** stops at its final **conclusion**; algorithms do the same [System 1 (associative thinking like 'stochastic parrots', what I have been doing in some of the present work), System 2 (logical, graphs etc.), Data Structures and Algorithms in the hierarchy etc.]—but whoever knows FSAs knows algorithms anyway; the **converse** [cf. inverse], however, may not **necessarily** be true.)

agentic workflows after OpenClaw

voluntary vs involuntary (e.g., reflexes)

System 1: mindless generation of grammatical, idiomatic language, think of metaphysical poetry from 16th century

semantic similarity cosine similarity, semantic spaces and manifolds from topology

pattern: regex matching, phrase matching

for each word I have $P(x \text{ after } y)$ and because w and u co-occur more frequently, the LLM decides to choose u after seeing w ...

Associative thinking: something LLM/the brain is reminded of—context window, all the tokens/words have equal probability for ATTENTION mechanism

System 2: GMAT, GRE, SAT, AP etc.

is metacognitive: for examples, thinking before speaking—which at least wise humans do. Cf. LLMs planning and LLMs doing what they planned.

Reasoning models

2. Some *Aulia* or the like giving you something to drink to cure some illness you have, wouldn't you drink that? That was in response to the question, the content of which in English would be, 'We could not actually drink a love potion, could we?' The love potion came from *Harry Potter* by the way ... including 'properties' etc. *Trust me*, I don't know what those things are. To the prompt about 'properties' I said, "Keats. Something like 'I have drunk of happiness.'" And then I said that I was not teaching poetry, so...
3. 'Amen!' ('*Tataasthu!*') not being reciprocated—when discussing mutually benefitting relationships or something. But this way, humans may be like parasites in such a relationship. [cf. theological arguments, e.g., Milton's *Paradise Lost—dialectic*]
4. Fermat's Last Theorem. See the stuff about 'hypothesis' below. I mentioned it while talking about *intermediate conclusions* recently.
5. Façade: while discussing the question about top management buying shares to create a false impression. In strategy and planning (I guess military strategy and planning), you never tell the enemy the status of your ammunition.
6. Free-body diagrams: the net effect will be (significantly) positive; the man will be able to pull the cart or whatever; the van having a trailer towed to it will return to equilibrium quickly enough etc.
7. (Old—right from the start, I should say) block diagrams: systems engineering, control systems, signal flow graphs [Nagrath, Ogata], trees etc.
8. (Old—January 2023) budget allocation for X for the question about allocating more than is necessary. *To reiterate, please read newspapers.*

puzzles – jigsaw, rubick's cube etc.

precedent – from legal reasoning, for example. SALIENT/SALIENCE

If all you want to read is things like J.H. Chase, better read non-fiction.

The issue is, no gaining from it in any sense.

Read extracts, like chapters, sections etc. from original writings Dickens, Joyce, Pynchon, Derrida, Barthes, Hegel, A.C. Bradley, Henry James, ... Not adapted like the Lambs' adaptation of Shakespeare's plays. **remove: Adaptations of *Illiad* and *Odyssey*.**

Gardiner is easy reading, so are Addison and Steele and so I am not suggesting these.

Harvard Business Review, for example, is also listed in relevant textbooks for Classes XI and XII by NCERT.

philosophy papers/books chapters

March 7, 2023, Talking the Talk

Look at the following paragraph.

There was once a man who made a lot of mistakes. He could get off every time he made a mistake by giving convincing reasons to the people affected. In fact, he convinced them that they actually profited from the situation. For instance, once when he was asked about the losses his choices incurred, he said that in the long term, those who questioned him would actually thank him for the same. He also said, "*Ipse dixit*, therefore I must be true." The people, who could not find answers to his quick-witted equivocation, repeated after him, "*Ipse dixit, ergo verum est*" **[you may find this in legal documents in 2026 or in logic books for logicians]**, or, "He says so, therefore it must be true".

There are many things that could be said[#] about this paragraph but I will focus on a few that are more relevant for the present purposes.

The paragraph illustrates the idea of ‘appeal to authority’. You may or may not have heard about it before (by ‘heard’ I mean ‘perceive’, by the way) but you will have used it many times. Other ways to argue about things include *reductio ad absurdum*, which sounds, among many other things, grand. But really, it’s just one of the things that you have done until high school—in proving that a number of the form **$2q + 1$ is an odd number***. Yet another way is *non sequitur***—something does not (logically***) follow something else. Cf. You already know this from SCHOOL.

#Note that on the GMAT Sentence Correction questions you will be suspecting the use of passive voice. Take note of such things as you read—this is something I have been saying all along.

*To recall, you start by claiming the opposite (proof by contradiction): that the number is even. You reach an *intermediate conclusion* (which means simply what it adds up to) that the number is real and integer at the same time. Since a number cannot be real and integral at the same time and an integer can either be even or odd at a given time, it follows that the number cannot be odd

**Something extraordinarily ordinary for me.

***I must inform the reader that ‘logically’ as I have heard it used has been used most [note my use of language here—‘most’] loosely. When I say ‘logically’ here, I mean it follows the *if...then...* conditional. [Now since this is in 2026, I can give you an obvious example: *if... then...* is how LLMs are answering questions to answer to research that they can assume all sorts of stuff] Also, there is no need to go into all of the details if your aim is only getting a good score etc. But you will need to follow me here, for example: that I lie does not mean that I am necessarily lying at a

given point of time, including at the time of this writing. [The only important part of the previous example is ‘necessarily’.]

February 17, 2023, Weaken the following (toy) arguments.

Internroom

You should join Internroom if you want to get good jobs. Internroom has been providing jobs to people for last five years and we have companies like Bergger King, Accede and Snupey hiring on a regular basis. We offer 90% placements every year. For those of you who would like to gain skills to get into these companies, we have launched training programs that cater to current industry requirements.

Sponsorship for College Festival

We are a leading university in the region and we attract talented students from all over the country. We also have student exchange programs, making us one of the most desired educational destinations. Previously, renowned organizations like Curolle, Goldminter and Sofista have sponsored our unique and hugely successful events. By sponsoring our events, companies have had extensive reach.

January 28, 2023, Critical Reasoning Notes for Some Particular Questions

8.1 If water conservation is the problem and it is fixed, their plan will succeed. The question is what will make the plan succeed.

8.2 Keeping everything else constant, the stools will bring in the money because people using them do not sit for long. The question is what will the stools do increase revenues and therefore profits.

8.3 After a threshold of miles per unit time, the expenses will increase and therefore there won't be saving. The question is whether a eco-friendly car model will cause savings for users.

8.4 Coffee is not what the business depends on for its survival. The question is whether giving away coffee for free will cause loss of (minimum viable) profitability.

8.5 Same as Dietz Foods. Current customers will go away; new customers won't come. This is the one where that particular items must stay on the menu because on this depends a substantial part of the clientele.

8.6 The research has already been performed. The newness of the product (when seen as a product!). People will not buy something they already have.

8.7 The rate of combustion for the two different waste material must be the same.
Equation-based. If it is not the same, then the amounts of products will differ and the situation requires them to be the same.

8.8 Doctors suggested so that people could be cured. Therefore, chlorine cannot be held to be the cause behind asthma.

8.9 Does not necessarily follow if exist causes X_n , n belongs to INTEGER. Look at the wording ('most vulnerable to'). (As I have mentioned above, it's an application of *non sequitur*.)

8.10 Likelihood. Compare the questions on Candle Corporation's targeting the right people to deliver emails and contingency system.

8.11 Conclusive evidence. For example, DNA over birth certificates.

January 13, 2023, A Little 'Diagnostic' Vocabulary (for the best ones)

Caveat: this is more about GRE than about GMAT, so do not fret if you get not a single one of them. I have written some example sentences to give some context, which may or may not help.

Pernicious: A pernicious feeling was taking root in Alex.
Qualify: Manoj Kumar qualified the claim that he was perfect by admitting that he made mistakes.
Obdurate: an obdurate attitude to things doesn't help a situation.
Poise, "such poise in your thoughts"
Inimical: The situation, with so many inimical conditions involved, was worsening by the day.
Preposterous: A preposterous child went up straight and demanded answer to a blunt question.
Fallow: The fallow land was considered by the government for a new use.
Chagrin
Gimmick
Interstitial
Pachydermatous
Lacrimal
Edify

Matutinal
Bagatelle
Conative
Encomium
Dossier
Precocious
Usurious
Modicum
telescope (v)
Viscounty
Camaraderie
Atavist

December 03, 2022, Weaken the Argument

This individual, Brad, helped me when I was in substantial trouble. I use the phrase 'Savior Brad'. I also form an opinion that Brad is impressive.

Given that:

Premise, P1: Only Christ or the like can be 'savior' or 'Savior.'

Premise, P2: Only God or the like can be 'impressive.'

Since P1 therefore not C1 (hidden part—can be called 'assumption': Brad is not Christ or the like.)

Since P2 therefore not C2 (hidden part—can be called 'assumption': Brad is not God or the like.)

December 18, 2022 Workshop on Critical Reasoning, particularly "Boldface"

What you learn here is applicable to all of Critical Reasoning. The other types, however, will have their focus on different things (conclusion, for example). I am giving you examples instead of

dictionary meanings, which you can look up anyway and looking up which will be a good exercise.

What do all those things *mean*?

1. *Claim*.

A claim can be a prediction, hypothesis, judgement, opinion, decision, belief etc. Let's look at each of these in turn.

i. Prediction: India will win the match; it will rain tomorrow. Even though it is highly likely that it will rain tomorrow, India will win the match. Generally the tense helps but it does not have to. As you read an argument, you assign some label to it provisionally. Later, it can turn out that the argument is actually trying to establish something you thought was a fact.

ii. Hypothesis: Fermat's Last Theorem, the proof of which was finally found recently, was taken as hypothesis until the proof was found. If you are interested, you can read about it on [National Science Foundation's website](#). Pythagoras theorem is a specific case of the general form $x^n + y^n = z^n$ and I have been talking about Pythagoras theorem every time I have to discuss proofs and the fact that facts can be used as claims.

iii. Judgement: Given the present status quo, the bench is of the opinion that the passing of this law holds merit and therefore the bench jointly and unanimously decides to direct the government to ensure its passage on a priority basis. (I made it up; please just take up any High Court or Supreme Court decision; if you're reading newspapers, you already know about some. See the section on Reading Comprehension below.)

iv. Opinion: "This teacher is so and so." "That student is so and so." "They should do this." Opinions are beliefs or judgement based on less-than-certain proof, that is, there is no definite proof for them. So, for example, 'first impression' gives you a fair idea of opinions.

v. Decision: Manoj Kumar saw X respecting his/her parents. Therefore, Manoj Kumar decided to start respecting his parents. The assumption is that Manoj Kumar thought that because X respected his/her parents, he should too. Of course, the thing hangs on what Manoj Kumar understands by ‘respecting someone.’

Examples of claims

I love making claims. I made these three claims years ago and they are still proving extremely helpful: “I am the president of America”, “I have read philosophy and psychology” and “I am teaching you now.”

a. “I am the president of America.” This claim is very easy to counter or weaken. “I have read philosophy and psychology.” This claim, among the three, is the hardest to say anything about (it’s a bit like, ‘try me’, so I will leave it there). “I am teaching you now.” This third one is an example where you cannot deny the claim except by saying that it is not true when you know it is.

b. Chemical X is the reason behind these plants thriving in metal-deficient soils. The structure is X leads to Y or if x then y. (official guide)

c. The claim of the motorists that there is traffic congestion is certainly unwarranted. This can also be framed as ‘opinion’ or ‘judgement’. (official guide)

d. The campaign did nothing to further Dietz’s economic interests. (official guide)

e. The concern that plastic sleds are more dangerous is clearly borne out by EVIDENCE. This is a claim containing something that can be called a claim (‘concern’). (official guide)

f. This circumstance (that they have a physically active lifestyle) explains the long lives of people in Wistar. This may be reduced to if x then y because ‘explains’ can mean more than just this relationship. (official guide)

g. The criterion to use to lay off people at this company (Vasquez-Morrell) is the average time taken by its claim adjusters to process claims. This is about deciding upon one option from among several available. (official guide)

h. Whenever two stars have the same chemical composition, they must have originated from the same cloud of gas. Note: ‘they must have originated’ means we are making a guess about the past—similar situations can include archaeological findings, investigation into an event (chemical leak at plants, see the relevant question) etc. (3) (official guide)

i. Candle Corp’s television stations are likely to have more income from advertisers than previously. This is a prediction. All predictions can be claims. All claims do not have to be predictions. (3) (official guide)

j. Most firms are likely to make more under the contingency-fee arrangement. This is a prediction. Note that in this question, only two types of arrangement are considered. (3) (official guide)

k. It is thus evident that less fossil fuel is being used as a result of the operations of these industries. (official guide)

l. This may be at least in part because the greater the awareness customers retain about the cost of an item, the more likely they are to use it. Claim saying that this is (part of) the explanation. The analogy that I had in my mind the first time I looked at this question was about the definition of a line—if it extends in one direction, it must also extend in the other. Plot it per Descartes if you find that abstract. (official guide)

m. The number of fast-food restaurants is likely to decrease. Prediction.
(official guide)

n. One possible explanation ... that thrushes need for migration and that insects lack.
(official guide)

o. This shows that felines were domesticated around the time farming began... Claim about the past. Compare with the question above ('must have originated'). (official guide)

p. This collapse exemplifies how even a single, apparently insignificant departure from safety standards can have severe consequences. Claim that negligence can lead to severe consequences. The form to which it can be reduced is if x then y. Also, 'butterfly effect'. (official guide). **Question to you: can the incident about the robot on moon or something be called the result of a butterfly effect?**

q. Leaks will become more prevalent if use of incineration increases. Prediction. (official guide)

r. Volunteer work leads to longevity. Compare with the question on Wistar above. (official guide)

s. If x then y: x is 'increased competition between employers for employees' and y is 'drove up the income for such employees'. (official guide)

t. The very insincerity that people decry shows that our government is functioning well. The form of the claim is again if x then y but the solution involves completing the form by accounting for other 'necessary' factors. Don't you remember 'necessary and sufficient' from math classes at school? (official guide)

u. The vacancies created by Spendless' arrival will be filled soon. Prediction. **Note that this argument uses analogy as its basis. There are questions on analogies too. Remember the old format of the GRE?** (official guide)

2. FACT:

A 'fact' for the purposes of our discussion is something that is established and not to be questioned for its authenticity. We must not deny a fact even if it may not strictly be *bona fide*. This is because, if facts given in the argument are not authentic, the entire argument collapses

anyway. As noted above, you must focus on how information is used in the argument rather than what it is in itself. It's the relation of the parts to the each other that these questions are about. Speaking of 'relations', don't you recall functions, relations and the rest from school? Using the analogy involving algorithm above, I can say that the algorithm will stop if one of the steps does not lead to the next. So, facts have to be taken as true for us to proceed with the argument. Finally, questioning a fact means making an argument out of it—the argument will then not be about the main conclusion given but about the truth or falsity of the fact we choose to question.

Examples of statements that can be used as 'facts':

- a. Stars are born in groups. (official guide)
- b. Politicians make insincere statements. (official guide)
- c. The study conducted showed certain results.
- d. The earth goes round the sun.

Note: If the argument takes 'the sun goes round the earth' as a fact, we do not deny it; even if we want to weaken it, we try to find something that talks about the parts of the argument which/that are not facts. These parts will be the relationship of things with other things in the argument and things absent (implicit/unstated assumptions).

3. PREMISE:

Any argument consists of only two things: a set of premises and a set of conclusions. For Critical Reasoning on the GMAT, the set of conclusions consists of only one conclusion (including conclusions like 'either this is reason or that is the reason' etc.).

Having said this, we can infer that, for a given argument, apart from the conclusion, everything is a premise. Yes, even facts are premises.

Then, in the right combination(s), the premises, if true, will make the conclusion true. Think of an algorithm or think about solving a set of linear equations: if you do not follow the steps in the right order(s), you will not get the answer.

However, note that boldface type questions will differentiate between, for example, ‘premise’ and ‘evidence’; ‘evidence’ can be a universal truth (‘earth goes round the sun’) or it can be a physical object (register showing some entry, DNA etc.). You need to learn to identify these distinctions while attempting the questions (all of them, not just boldface type). Similarly, from my discussions, ‘obvious truth’ and ‘generalization’ are two different things but if you cannot realize the distinction, go for the other parts of the options and eliminate based on those.

Beliefs can be premises too. An example of a belief is that I have these people as my parents, but if someday it turns out otherwise, I cannot be blamed for believing something false.

4. CONCLUSION:

As I have said elsewhere, a ‘conclusion’ is what an argument exists to prove. The examples I have given so far in the classes include:

-- I tell you some good things about me. The conclusion can be that I wish to impress you or that I am the right candidate for this job.

-- Umbrellas protect us from rain. It is raining hard and I need to go out urgently. I have an umbrella and it works well. I decide to take the umbrella with me.

-- I want to buy fruits. I go to a market. I visit several shops with a variety of fruits of good quality and within my budget and I browse through the products these shops sell. I come back from the market.

-- What can you conclude about my buying fruits? Can you conclude, for example, that the fruits were good or that the market was closed or that I brought fruit juice from off the street? These are a few of the patterns that you will find as you consider each of your Critical

Reasoning questions (particularly the types boldface and all-of-the-given-information-supports-what).

5. EVIDENCE:

You already know about evidence, don't you?

The examples that I gave in the workshop include the one about Manoj Kumar below. Also note that, as I have only very recently said, Manoj Kumar might as well be a molecule or some such thing in a chemical analysis.

- What is the evidence that the classes were conducted?
- Check attendance records, check students' notebooks, check homework and assignments etc.
- What is the evidence this is person who was present there at that time?
- He was seen by several people when he was leaving the place.
- His fingerprints were found at the place.
- What is some possible counter-evidence for this?
- He visited some other part of the place or he happened to enter the place and then leave coincidentally.
- The fingerprints might have been planted there.
- What else can help us save this person?
- Another person was hiding in the place and left undetected. Needless to say, that he was hiding needs to be ascertained to claim/assert/say this.
- DNA found at the site can be used to say certainly that these people belonged to kingdom F and not kingdom G. (official guide question)
- The date fell on a Friday and therefore Thorpe's book must have been published/written around 1409. (official guide question)

6. HYPOTHESIS:

- There is a new type of particle, called the muon. This proposed thesis will try to establish its existence.
- On average, the concentration of sodium in the solution is no less than 600 ppm.
- The main reason behind the birds' death is the presence of some substance(s) released into the forest because of the discharge from a nearby industrial plant.

7. PREDICTION:

- India will win the match.
- The incidence of COVID-19 in this region will increase at this rate in the coming three months.
- The safety rules, when implemented, will result in a rise of the number of passengers by at least 10%.
- The sales forecast for the next quarter is X% year-on-year.
- The throw of the three dice will result in all sixes.

8. ASSUMPTION:

- Shopkeeper or algorithm sees someone browsing her store and makes some recommendations. Assumption(s): if you liked this, you might be interested in these.
- According to my values, a person in this position should behave in such and such a way because that is what is appropriate for him or her. Assumption(s): what I think matters. What I think will make a difference (at least to the present situation). I want to make difference by asserting my opinions if I present this opinion as a claim.

9. GENERALIZATION:

Dogs chase cats.

Manoj was defrauded by some people in Mumbai. Therefore, Manoj's [conclusion was the generalization] that there were swindlers in Mumbai. [You need to track how and why you generalise, for example, Is it based on statistical prominence? On associationist inferences? On personal taste? On previous reading or knowledge? On previous structures (of arguments etc.)? The passage will never have sufficient information for you to generalise about any part of its CONTENT. But it will have sufficient information about its STRUCTURE for you to generalise to form a SUMMARY. Further, this gets into types of EVIDENCE and its admissibility. On this, I can assign reading from *Artificial Intelligence (AI) in Forensic Sciences* by Zeno Geradts (Editor), Katrin Franke (Editor). For scientific research, the evidence hierarchy will be different from that for forensics. Inductively, from what I can see as of now, evidence hierarchy is discipline-specific and since reading from various disciplines is presented in the present context, one must learn which type of evidence is applicable to which domain.]

10. REASON: Reasons will generally be causes and series of propositions/statements that will lead to a conclusion. One particular cause does not have to be the cause behind an effect. Second, when there is one cause, there won't be another cause. This is opposed to situations where you could have weighted causes, so to speak, that lead to some effect—you have all read polynomials and equations so you know what I mean by that, for example: $Y = \text{Sigma}(W_i * X_i)$. Generally, the questions are about *the cause behind something*. It could be the case that there are several causes out of which one is a possible cause but that particular cause does not have to be the cause (*non sequitur*, as noted above). This is exemplified in an official question, by the way.

11. CONSIDERATION:

-- If the probability of people meeting the avalanches in Sordellian mountains decreases, then the number of accidents will be affected (one way or other). Or, what if the probability of people meeting the avalanches decreases?

-- What if archaeological evidence exists buried inside the earth but not excavated yet?

-- What if the ore contains the element in a form from which it is not feasible to extract this element?

12. JUDGEMENT:

-- This is one of the best/worst/most mediocre teachers that I have met so far. I have evidence of some presentations from her/him to support my judgement.

-- This part of the syllabus appears easy.

-- This person or system is not the right person or system to judge my abilities.

-- We should go for this decision/plan/product/etc. rather than that one.

-- The jury is of the opinion is that the accused is...

13. OPINION: "God is impressive."

According to my values, a person in this position should behave in such and such a way because that is what is appropriate for him or her.

14. JUSTIFICATION: I am right in doing this. Justification: I did this because that is what the society does under such circumstances today.

15. PROOF:

We do not need to discuss proofs. I did not discuss them during the workshop but I did give a proof for the boldface type question on Anasazi centre:

P1

P2

Thus, P3

The actual solution looks somewhat like this:

if (if (They had capacity) then (they imported timber)) and (massive buildings have been found) then (the place must have been a major Anasazi centre)

Generally,

if (if (premise 1--required) then (premise 2--evidence)) and (premise 3--evidence) then
(main conclusion)

In any other combination, it will not work. For this particular argument, this proof is valid.

16. COUNTER:

‘Counter’ is between ‘weaken’ and ‘disprove’. It is close to ‘disprove’.

-- Example of ‘countering’ something:

-- ‘For’ is avoidable on the GMAT.

-- Counter: An option containing ‘for’ is the answer for one of the questions in one of the official practice questions.

17. ENTAIL:

--The same as ‘imply’, ‘implicate’ and ‘implication’ and somewhat loosely, ‘if x then y’.

--To ‘entail’ is to ‘necessarily follow.’ The word ‘necessarily’ is all-important here.

-- Example: Everybody must abide by the rules.

It entails that nobody is allowed to break the rules.

18. IMPLY: Very roughly and in no case formally, the same as ‘entail’.

19. IMPLICATION: Very roughly and in no case formally, the same as ‘entail’.

20. INFER:

Example 1:

$$3 + 1 = 4$$

$$1 + 3 = 4$$

Therefore, $3 + 1 = 1 + 3$ given that we know $4 = 4$.

Example 2:

John said that Harry looked awesome.

Then John said that he was being sarcastic.

Therefore, given that John's intentions are represented as-is in the premises, John thinks that Harry did not look awesome. (Or worse, but you got the point.)

21. DECISION: We make decisions all the time. You can draw on your own experiences as well as your knowledge. Example: I have decided to take this course because this will allow me to study this other subject further.

November 04, 2022, Critical Reasoning

--When we say the conclusion is X, we mean the argument is X. Remember that *the argument exists to prove its conclusion*. Also, for certain types of question, like find the conclusion or the information given supports what and reconcile the findings, there will be no conclusion. Also, the conclusion of the argument answers a definite question (any type of question: what, when, yes/no, where, how etc.—you know this from your knowledge of language already), for example, “Whether, in the given situation, the profits will decline or not.”

--If you say something is true for 100% of the population, you will be vulnerable to attack. So, be careful with ‘extreme’ choices. An example, borrowing from Reading Comprehension, is the use of ‘dismissal’ where the author actually gives a balanced perspective (of his or hers).

--The same reasoning as used above applies to cases where we have indefinite references like ‘some’, ‘few’ etc.

--Options which talk about it can be something like ‘the likelihood of sighting a mountain lion is the same (=not higher than/less than etc.) in this region as it is in that region’, which means that perhaps the option will not help me if I am trying to weaken or strengthen something, agreed?

--Facts must not be denied because that means that the study mentioned needs to be conducted again and this is the same as saying that the entire question needs to be changed/scrapped altogether. This is as discussed above.

--Everything that can be called a claim (see above) can be attacked or supported, as opposed to facts.

--Focus on the wording of the question and of the options: they change it and you have to be prepared for it, e.g., find ‘a serious potential drawback’ (emergency services like fire brigade vehicles must not stop because of the speed humps, right?). In this one, the other choices will be relatively minor drawbacks. For wording used in options, examples are questions which need a dramatic change in some figures to explain some observations.

--Make sure you understand the argument and the side that you have to take. It's a common design pattern where the options do the opposite of what you are supposed to do with the argument. In explain-type questions, you will have to bring together/support both the sides.

--Almost all CR questions can be framed as weaken or support questions because an argument is either or invalid (it is raining or it is not--even if it is a light drizzle, it is raining, right? Or, the answer to the question, "Is it day or is it night?" will be day or night, not evening/twilight.) Please note that I do not discuss Schrodinger's cat because I do not have to. I do discuss good examples but where I incentive to—for example, where I can tell people they can score the maximum possible marks and, on a lighter note, where I feel like I am the teacher.

--There is overlap in the categorization: if we agree that every argument exists to prove its conclusion, we can proceed to say that the goal of the argument is to prove the conclusion, right? "Seek purpose" is what I said in a recent class, by the way. And I have been talking about 'bull's eye' and 'bird's eye' (*Arjun* and *Dronacharya* etc.) all along, of course. So, if it's a whether-question, it may not help to determine 'to what extent' etc.

September 30, 2022, Another Example

You are in a jungle. There is no network. But since premium subscription on the app allows you to download your entire playlist on your device, you don't have to worry about network access! Therefore, buy premium access now!

What is the nearest assumption on which the argument depends?

- A. People will download playlists before visiting a jungle.
- B. People are likely to want to listen to songs in jungle.
- C. People like jungles and songs and the idea of visiting jungles to listen to songs.
- D. People will start visiting jungles to listen songs after they buy the service.
- E. People can't do without songs but they can do without jungles.
- F. The marketing team couldn't come up with a better idea and they had to meet targets.
- G. From the data gathered by a myriad of sensors placed all over the jungles for the past two years, it was concluded that visitors in jungles get bored and songs proved to be the remedy and panache as the animals thought little of the visitors.

Somewhere in September 2022, What is the assumption on which the conclusion/argument depends?

In a meeting, the chairperson had said something. One of the attendees pointed out that the chairperson made a mistake. So chairperson put it to vote. It turned out that the majority voted that the chairperson did not say something wrong. Therefore, the chairman did not say something wrong.

1. The way to decide the question is to put it to vote, in this case, a kind of plebiscite.
2. The majority votes conclusively decide the matter.
3. The majority's decision will be final.
4. The result of the vote decides the question at hand.

July 09 2026: Google AI Studio

Metacognition and **reasoning** about a text as tested on reading comprehension tests and critical reasoning texts.

In standardized examinations—such as the SAT, GRE, GMAT, LSAT, and MCAT (CARS)—reading comprehension (RC) and critical reasoning (CR) sections evaluate much more than vocabulary or literal decoding. They are explicitly designed to test **metacognition** (the ability to analyze, monitor, and evaluate one's own thinking processes) and **logical reasoning** (the ability to dissect, reconstruct, and critique arguments).

Understanding how these tests evaluate these skills can help clarify the cognitive demands placed on test-takers.

1. Metacognition in Reading Comprehension (RC) Tests

In reading comprehension, metacognition is the "active monitoring" of how well you **understand** a text and **how the pieces of the text fit together**. Standardized tests measure this through several distinct question types:

- **Evaluating Authorial Intent and Strategy:** Metacognitive readers do not just ask, *"What is this paragraph saying?"* They ask, *"Why did the author put this paragraph here?"*
 - *Test Application:* Questions that ask you to "determine the primary purpose of the passage" or ask "why the author mentions [a specific detail]" require you to step back from the literal content and analyze the author's rhetorical strategy.
-
- **Recognizing the Boundaries of Knowledge:** A key metacognitive skill is knowing what you *do not* know or what the text *does not* state.
 - *Test Application:* **Inference** questions ask you to identify what must be logically true **based only on the text**. Incorrect answers often present facts that are generally true in the real world but are unsupported by the passage. Success relies on your metacognitive ability to separate your personal external knowledge from the strict boundaries of the text.
-
- ~~**Tracking Comprehension Shifts:** Dense academic passages often introduce a traditional theory, critique it, and then offer a nuanced alternative.~~
 - ~~*Test Application:* Questions regarding the "author's attitude" or "tone" test whether you noticed subtle shifts in perspective. If you read passively, you might mistake a counterargument the author is dismissing for the author's own opinion.~~
-

2. Metacognition and Reasoning in Critical Reasoning (CR) Tests

Critical Reasoning questions (often found on the GMAT and LSAT) present **short arguments** and ask you to analyze their logical validity. This requires high-level logical reasoning coupled with metacognitive oversight to avoid falling into cognitive traps.

- **Deconstructing Argumentative Structure:** You must mentally map the argument into its core components: the *Premise(s)* (stated facts), the *Conclusion* (the main claim), and the *Assumption* (the unstated bridge between them).
 - *Test Application:* "Role of Boldface" or "Method of Reasoning" questions ask you to identify the function of specific sentences (e.g., whether a sentence is a finding, an intermediate conclusion, or a counter-premise). This requires a metacognitive awareness of how arguments are built.
-
- **Identifying the Unspoken (Assumptions):** Finding an assumption is fundamentally a metacognitive task because it requires you to identify what is *missing* from the text rather than what is present.
 - *Test Application:* "Assumption" questions require you to find the hidden vulnerability in an argument. To do this, you must actively look for "gaps" in the logic—areas where the author made a leap from one concept to another without justification.
-
- **Evaluating Logical Strength (Weaken/Strengthen):** These questions test your ability to predict how new, hypothetical information would interact with the existing argument.
 - *Test Application:* You must evaluate five independent statements and determine which one most undermines or supports the author's conclusion. This requires reasoning about causality, correlation, and potential alternative explanations.
-

3. How Tests Exploit Metacognitive Failures (The Distractors)

Test-makers do not just write one correct answer; they carefully design incorrect answers ("distractors") that exploit **common human cognitive biases** and metacognitive lapses:

- **The "Familiarity" Trap (Recognition vs. Understanding):** An incorrect choice will often use exact words or phrases lifted directly from the passage, but arrange them in a way that alters the logical meaning. Passive readers choose these because their brains recognize the familiar words and mistake recognition for comprehension.

- **Out-of-Scope (OOS) Distractors:** These options contain claims that sound highly plausible and reasonable to the average person, but they cannot be proven by the specific text provided. They exploit *our tendency to rely on external assumptions and common sense rather than strict textual evidence*.
- **Extreme Language:** Options containing absolute words like *always*, *never*, *all*, or *none* are often incorrect because *real academic arguments are highly qualified*. Standardized tests evaluate whether you have the metacognitive discipline to notice when an answer choice oversteps the moderate bounds of the passage.

4. Metacognitive Strategies for Improving Performance

To perform well on these assessments, high-scoring test-takers use specific metacognitive strategies to regulate their thinking:

- **Active Self-Interrogation:** While reading, periodically ask yourself:
 - *"What is the author's main point so far?"*
 - *"Why did they introduce this contrast?"*
 - *"Am I losing focus, and do I need to reread the last sentence?"*
 - *That's nonsense—you can't do that/you can't afford to do that.*
- LEARN TO READ AS FAST AS YOU CAN.
- Unless it *Joyce's Ulysses*, you won't have to spend a lot of time—for example, if it's a novel written in today's English, you will be able to read it very fast.
- Novels is one genre—you need to read editorials, critical pieces etc.
- **Pre-Phrasing (Predictive Thinking):** Before looking at the multiple-choice options, formulate your own answer to the question based on your reading. This acts as a cognitive shield. If you have a clear idea of the correct answer beforehand, you are much less likely to be swayed by the clever, misleading wording of the distractor choices.
- What did you understand?
- "ground truth"
- **Error Analysis Logging:** When reviewing practice exams, instead of just looking at the correct answer, analyze *why* you chose the wrong one. Was it a comprehension error, a misreading of the question stem, or a failure to notice a subtle logical shift? Identifying your own patterns of error is a highly effective way to build metacognitive control.
- It can also be that you had to choose something and click 'Next'.

What is the authority you use to say all of this? Give me a bibliography.

The concepts and frameworks discussed in the previous response are grounded in several decades of research spanning **cognitive psychology**, **educational measurement**, and **applied linguistics**.

To understand how reading comprehension (RC) and critical reasoning (CR) tests assess these skills, researchers analyze how human minds monitor their own understanding (metacognition) and process logical structures under high-stakes conditions.

The following bibliography organizes the primary authoritative sources, theoretical frameworks, and psychometric studies that substantiate these concepts.

I. Foundational Metacognition & Metacomprehension Research

These seminal works define "metacognition" and demonstrate how readers actively monitor their comprehension (or fail to do so, falling into the "familiarity trap").

- **Baker, L., & Brown, A. L. (1984).** *Metacognitive skills and reading*. In P. D. Pearson (Ed.), *Handbook of Reading Research* (Vol. 1, pp. 353–394). Longman[1].
 - *Significance:* This foundational chapter details how active reading relies on metacognitive monitoring—such as self-interrogation and adjusting reading speed when a breakdown in comprehension is detected.
- **Note that the study was done on kids and see below—I prompted for studies for adults.**
- **Flavell, J. H. (1979).** *Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry*. *American Psychologist*, 34(10), 906–911.
 - *Significance:* The seminal paper that defined metacognition (thinking about thinking) and established the framework for how individuals monitor, regulate, and evaluate cognitive enterprises.
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- **Kintsch, W. (1998).** *Comprehension: A paradigm for cognition*. Cambridge University Press[2].
 - *Significance:* Explains the "Construction-Integration" model of reading[2]. It details how a reader transitions from a literal representation of text (the "surface structure") to a conceptual understanding (the "situation model"). Standardized RC tests deliberately target the latter, requiring readers to construct a mental model of the author's argument.
-
- **Dunlosky, J., & Lipko, A. R. (2007).** *Metacomprehension: A review of calibration and its relation to reading comprehension. Part II: Applied Metacognition*, 22(4), 225–232.

- *Significance:* Investigates "calibration accuracy"—the correlation between a reader's perceived understanding of a text and their actual performance on a comprehension test. It explains why poor readers frequently suffer from an illusion of comprehension (often caused by recognizing familiar words in incorrect distractor choices).

●

II. Applied Metacognitive Strategies in Testing

These studies examine how metacognitive strategies (such as pre-phrasing, predicting, and structural mapping) directly correlate with higher scores on standardized reading assessments.

- **Mokhtari, K., & Reichard, C. A. (2002).** *Assessing students' metacognitive awareness of reading strategies.* *Journal of Educational Psychology*, 94(2), 249–259[3].
 - *Significance:* Introduces the Metacognitive Awareness of Reading Strategies Inventory (MARSI). It highlights that top-performing readers systematically utilize "Global Reading Strategies" (like analyzing text structure and predicting content) and "Problem-Solving Strategies" (like re-reading difficult sections)[3][4].
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- **Dunlosky, J., Rawson, K. A., & Hackney, L. (2002).** *How disconfirming cues affect metacomprehension accuracy.* *Journal of Educational Psychology*, 94(2), 249–260[2].
 - *Significance:* Outlines the "levels of disruption" theory[2]. It illustrates how readers use cues (like encountering a highly complex logic chain or unfamiliar syntax) to evaluate their own comprehension. Standardized tests exploit these cues by framing distractors using familiar language, bypassing a reader's internal warning system.
-

III. Cognitive Psychology, Dual-Process Reasoning, and Biases

Critical reasoning sections evaluate a test-taker's ability to override intuitive, fast heuristic thinking in favor of slow, deliberate logical reasoning.

- **Kahneman, D. (2011).** *Thinking, Fast and Slow.* Farrar, Straus and Giroux.
 - *Significance:* Details the dichotomy between System 1 (fast, emotional, intuitive, and associative) and System 2 (slow, deliberative, logical, and effortful) thinking. Standardized "distractor" design relies on provoking a System 1 response (e.g., choosing an answer that "feels right" or matches real-world assumptions) to catch test-takers who fail to engage System 2 oversight.

- - **Stanovich, K. E. (2011).** *Rationality and the reflective mind*. Oxford University Press.
 - *Significance:* Explores the concept of "dysrationalia"—the inability to think and behave rationally despite having a high IQ. Stanovich explains that critical thinking assessments measure the "reflective mind's" capacity to override cognitive biases (such as confirmation bias), a process requiring active metacognitive monitoring.
 -
-

IV. Psychometric & Test Developer Frameworks

These sources from official standardized test administrators explain the exact constructs their verbal reasoning sections are built to measure.

- **Law School Admission Council (LSAC).** *LSAT Logical Reasoning*. Official LSAC Resource Guidelines[5].
 - *Significance:* Explicitly defines the construct validity of Logical Reasoning[5]. The LSAC states that these questions test the examinee's ability to "recognize parts of an argument and their relationships," "detect assumptions made by particular arguments," "identify flaws," and "determine how additional evidence affects an argument"[5]—the exact structural and logical components described in Section 2 of the previous response.
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- **Educational Testing Service (ETS).** *The TOEFL and GRE Reading Frameworks (Research Reports)*. ETS[6].
 - *Significance:* Research bulletins from ETS outline how reading comprehension is measured. They describe reading not as a passive retrieval of facts, but as an active, goal-directed cognitive process where the reader must distinguish main ideas from supporting evidence, identify rhetorical strategies, and infer the author's perspective[6].
-

Sourceshelp

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2. tandfonline.com
3. waldenu.edu
4. waldenu.edu
5. lsac.org
6. readingrockets.org

Yes, there is a substantial body of research examining metacognition, reading strategies, and comprehension monitoring in adults.

In fact, Linda Baker herself followed up her work on children by publishing a major review paper in 1989 specifically focused on this population, titled "Metacognition, Comprehension Monitoring, and the Adult Reader".

Research on adult metacognition in reading typically spans three major areas:

1. Studies on College Students and Postsecondary Learners

A significant portion of adult reading research focuses on university students. Because academic texts are highly complex, researchers study how young adults evaluate and regulate their understanding.

- Key Finding: Just like with children, there is a strong correlation between a college student's reading proficiency and their metacognitive awareness. Stronger students actively deploy "repair strategies" (like pausing, slowing down, or self-questioning) when they hit a confusing passage, whereas weaker students tend to plow through the text without realizing they have missed the meaning.

2. Studies on Struggling Adult Readers and Adult Literacy

Researchers have adapted the "error detection" and strategy-training paradigms originally used with children to help **adults in literacy programs** or those with reading difficulties like dyslexia.

- Key Finding: A 2022 study titled "Do Struggling Adult Readers Monitor Their Reading?" found that struggling adult readers frequently struggle to track their comprehension in real-time (online monitoring).
- Research in adult literacy shows that explicitly teaching adults metacognitive strategies—such as questioning, summarizing, and mapping concepts—greatly improves their reading comprehension, much like the "Reciprocal Teaching" methods used with middle schoolers.

3. Lifespan and Aging Studies (Younger vs. Older Adults)

Cognitive psychologists also study how metacognitive reading skills shift as adults age.

- Key Finding: A 2023 study published in Educational Gerontology compared younger adults (ages 18–29) with older adults (ages 60–75) using inconsistency-detection tasks. The researchers found that while older adults sometimes reported noticing fewer contradictions in complex texts, this was primarily mediated by natural age-related changes in working memory and processing speed, rather than a loss of metacognitive knowledge itself.

General Conclusions from the Adult Literature

When comparing the adult literature to Baker and Brown's foundational work on

children, two notable trends emerge:

- "Calibration of Comprehension" is hard for everyone: Studies consistently show that even highly educated adults are remarkably poor at predicting how well they performed on a reading test. Adults frequently exhibit an "illusion of competence," believing they understood a text far better than they actually did.
- Strategy instruction is still effective: The same metacognitive strategies developed for kids—such as self-monitoring, setting goals before reading, and evaluating the text—remain highly effective when taught to adult learners.

Edited AI CHAT

Your assertion touches on foundational principles in cognitive psychology, educational theory, and dual-process models. To evaluate your statement, we can break it down into two core claims and look at how established and contemporary research aligns with, qualifies, or refutes them.

Part 1: "Seeing a passage a second time is DIFFERENT..."

Scientific Alignment: Confirmed

Cognitive science and reading comprehension research strongly support the idea that a "second pass" (rereading) is fundamentally different from a "first pass" (initial reading)[1][2].

1. **Reduction in Cognitive Load:** During the first reading, a reader's working memory is heavily taxed by lower-level processing: decoding vocabulary, parsing syntax, and establishing a basic literal understanding of the text (often referred to as building the "textbase representation")[3]. In the second pass, because this semantic framework is already established, the **extraneous and intrinsic cognitive load is dramatically lowered**[4][5].
2. **Freed-Up Working Memory for Higher-Order Thinking:** With lower-level tasks automated or cached from the first pass, the reader's working memory capacity (as conceptualized by Alan Baddeley) is freed up[3][6]. This allows the reader to shift from basic comprehension to **deep, inferential, and generative processing**—making complex connections, synthesizing concepts, and engaging in critical analysis that is nearly impossible during a first reading[7][8].
3. **The "Illusion of Knowing" (A Necessary Qualification):** There is, however, a cognitive trap to rereading. In a second pass, a reader experiences **processing fluency**—the text feels "easy" because it is familiar. In classical dual-process theory, this fluency can trigger **System 1 (fast, intuitive processing)**[9][10], leading the reader to believe they understand the material deeply when they actually only *recognize* it[10]. This is known in educational psychology as the **"illusion of competence"** or a **metacomprehension error**. Therefore, "deliberate thinking on notes" is essential to snap the brain out of a lazy System 1 fluency trap and force it back into active, analytical processing.

Part 2: "...deliberate thinking on these notes is beyond, or extending SYSTEM 2."

Scientific Alignment: Qualified (Disconfirmed by classic models, but supported by extended/tripartite models)

Depending on which theoretical framework you use, this claim can be interpreted in a few different ways:

A. Under Classic Dual-Process Theory (Kahneman & Evans)

- **Disconfirmed:** In the classic dual-process framework popularized by Daniel Kahneman (*Thinking, Fast and Slow*) and Jonathan Evans, **System 2** is defined precisely as slow, effortful, rule-governed, logical, deliberative, and conscious processing[9][10].
- Within this strict model, "deliberate thinking on notes" is not *beyond* System 2; it is the **textbook definition of System 2 in action**[10]. Therefore, claiming it is "beyond" System 2 is technically a category error in the classic, two-system model.

B. Under Stanovich's Tripartite Model of Mind

- **Confirmed (as an "Extension"):** To support your intuition, you can look to the work of **Keith Stanovich** (the cognitive scientist who originally coined the terms "System 1" and "System 2"[10]). Stanovich argued that the simple dual-process model is too restrictive and proposed a **Tripartite Model** that partitions the traditional System 2 into two distinct minds[11][12]:
 - **The Algorithmic Mind (Standard System 2):** This handles raw computational horsepower, working memory operations, and cognitive decoupling (fluid intelligence)[11][13].
 - **The Reflective Mind:** This handles cognitive dispositions, metacognition, and thinking strategies[11][13]. It is the Reflective Mind that decides *when* and *how* to deploy the Algorithmic Mind to evaluate beliefs, monitor comprehension, and review notes[11][12].
 - If we map your statement to this model, active metacognition—reviewing, evaluating, and deliberately synthesizing notes—**extends beyond simple algorithmic processing (System 2)** and enters the domain of the **Reflective Mind**[11][13].
-

C. Contemporary Concepts of "System 3" (Externalized or Metacognitive Cognition)

- **Supported by recent theories:** In recent cognitive science literature, researchers have increasingly proposed a **System 3** to capture processes that do not fit neatly into the biological "fast vs. slow" loop:
 - **Metacognitive Super-layer:** Some cognitive architectures define "System 3" as a **meta-cognitive supervisor layer**[14][15]. This is the part of the brain that continuously monitors cognitive performance and coordinates both System 1 and System 2[14].
 - **Externalized / Augmented Cognition:** Other contemporary frameworks (such as Tri-System Theory) describe "System 3" as **externalized, scaffolded cognition**[16]. Because humans use physical external tools—such as written notes, diagrams, or digital interfaces—to offload working memory, this interaction creates a "System 3" loop that

physical biological brains cannot achieve alone[16][17]. In your classroom context, deliberate thinking *on notes* is a classic example of this externalized, scaffolded cognitive loop.

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Types of puzzle; types of logic puzzle

zebra puzzles in aptitude tests

Example: not understanding a thing as a measure of ‘difficulty’

Google Gemini output

To understand how functional analysis applies to modern machine learning, it is helpful to look at how theoretical researchers analyze these systems. While models process finite data (like a 12,288-dimensional vector or a sequence of 4,096 tokens), mathematically understanding their behavior, generalization boundaries, and limits as they scale requires treating them as **infinite-dimensional objects**[1][2][3].

Here is how functional analysis provides the mathematical machinery behind **semantic spaces, manifolds, and global generation in diffusion models**:

1. Semantic Spaces: Embeddings and Attention as Operators

In Large Language Models, semantic spaces are initially defined as high-dimensional vector spaces (embeddings). However, as these dimensions scale and sequence lengths grow, researchers model these interactions using infinite-dimensional spaces.

synthesis

when encountered in a discussion of thesis, antithesis etc. syn - thesis

defaults, ranking – what’s the first meaning that comes up when I see a word, ‘synthesis’

For example, thematic analysis – you have to focus on a set themes throughout the work/novel

short texts

empirical – the way they keep churning out new books

question the sources – that is also where

literature review to find research gaps, called scoping review

RESULTS SECTIONS ONLY

if the texts are not labelled/organised thematically, it will be too much work

books of abstracts

for english, the idea is to develop a habit of ignoring function words (grammatical words),

I have been to the enormous place that was hid underneath the ... that juts out into the sea/sky.



The Transformer as an Operator on Banach Spaces

A Transformer takes an input sequence of tokens and maps it to an output sequence of tokens.

Mathematically, we can treat the input sequence as a continuous function

$X(t)$ and the output as $Y(t)$ [2]. The Transformer itself is an **operator** $T: X \rightarrow Y$ mapping one function space to another [2].

- **Non-Mercer Kernels in Banach Spaces:** In classical machine learning, similarity in semantic spaces is modeled using Hilbert spaces (specifically, Reproducing Kernel Hilbert Spaces, or RKHS) because they rely on symmetric, positive-definite "Mercer" kernels. However, the dot-product attention mechanism in Transformers is highly asymmetric and indefinite (queries and keys play different roles).
- Research has shown that the Transformer's attention mechanism is mathematically equivalent to a kernel learning method acting on a pair of dual **Banach spaces** (specifically, a Reproducing Kernel Banach Space, or RKBS) with an **infinite feature dimension** [1]. Using functional analysis, researchers proved a *universal approximation theorem* for Transformers, showing how they can learn any continuous binary mapping between these infinite-dimensional Banach spaces [1].

2. The Manifold Hypothesis and Spectral Geometry

The **Manifold Hypothesis** states that high-dimensional real-world data (such as the distribution of natural human language or natural images) does not fill the entire embedding space

$\mathbb{R}^d$. Instead, it concentrates on or near a much lower-dimensional, highly curved, non-linear subspace called a **manifold** $(M, \mathcal{M})$.

Analyzing

$L^2(M)$ $L^2(M)$

via **Operator Theory**

To study how an LLM navigates and represents this manifold, we look at the infinite-dimensional Hilbert space

$L^2(M)$ $L^2(M)$

—the space of all square-integrable functions defined on the manifold

M .

- **The Laplace-Beltrami Operator (LBO):** The geometry of the manifold is analyzed using the Laplace-Beltrami operator, which is an unbounded, self-adjoint linear operator acting on $L^2(M)$.
- **Spectral Geometry:** By calculating the eigenvalues and eigenfunctions of this operator (its "spectrum"), we get a geometric equivalent of the Fourier transform for that specific manifold.
- Functional analysis explains how LLMs successfully generalize: when a model learns semantic embeddings, it essentially aligns its representation layers with the dominant eigenfunctions of the Laplace-Beltrami operator. This mathematical alignment ensures that moving through the embedding space corresponds to smooth, semantically continuous transitions along the underlying data manifold.

3. Diffusion Models' "Global Generation" in Function Space

Standard diffusion models (like those generating images or audio) are typically formulated in finite-dimensional Euclidean space $(\mathbb{R}^d, \mathbb{R}^d)$, where they gradually denoise a vector of pixels. However, to achieve **global generation**—generating continuous, resolution-independent functions (such as continuous trajectories, 3D shapes, or infinite-resolution images)[4]—the mathematics must be formulated directly in **infinite-dimensional function spaces**[4][5].

The Measure Problem: No Infinite-Dimensional Lebesgue Measure

In finite dimensions, we define the "score function" of a diffusion model as the gradient of the log-density:

$$\nabla_x \log p(x) \quad \nabla_x \log \tilde{p}(x)$$

. However, a fundamental result of functional analysis is that **there is no infinite-dimensional analogue to the Lebesgue measure** (you cannot define a uniform "volume" in an infinite-dimensional space)[6].

Therefore, $p(\mathbf{x})$ $p(x)$ does not strictly exist.

- **Radon-Nikodym Derivatives:** To bypass this, functional analysis uses the **Radon-Nikodym theorem**. Instead of defining an absolute probability density, we define probability measures *relative* to a known reference measure (usually a Gaussian Process)[4][5].
- **Fréchet Derivatives for Score Matching:** Because we cannot take a standard gradient in function space, researchers use the **Fréchet derivative** (the generalization of the derivative to Banach spaces)[7] to compute the score of these Radon-Nikodym derivatives[4]. This allows "Denoising Score Matching" to be mathematically rigorous in infinite dimensions[4].

Fokker-Planck Equations and Semigroup Theory

The forward and backward processes of a diffusion model in function space are described by infinite-dimensional Stochastic Differential Equations (SDEs)[8]. The evolution of these probability distributions is governed by the Fokker-Planck equation (a partial differential equation)[8].

- To prove that the reverse generative process stably converges to the true target data distribution, mathematicians rely on **strongly continuous semigroups** (C_0 C_0 -semigroups) of operators on Banach spaces[8]. The semigroup framework provides the exact mathematical proofs for the stability, existence, and uniqueness of these generative trajectories, ensuring the model can globally generate cohesive, continuous data[8].

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An Example of What not to Do on the Exam

CR(18) 13/08/22

Let n_L denote the number of children injured last year
 Let n_{L-10} denote the number of children injured 10 years ago
 $n_L > n_{L-10}$ (given)

Assumption 1: $n_L = n_W + n_P$ (we can make this assumption)

where n_W = number of injuries due to wooden sleds
 n_P = number of injuries due to plastic sleds

Assumption 2: $n_P > n_W$ because 10 yrs ago, plastic sleds became popular.

Only when this holds, can the author attribute the concern regarding the danger posed by plastic sleds to $n_L > n_{L-10}$, or else the argument will become self-contradictory. Q.E.D.

If we take into account the probability with which these events occur:

$P(\text{injury} | W) = \text{probability that injury resulted after } W$
 $P(\text{injury} | P) = \text{probability that injury resulted after } P$

if $P(\text{injury} | P) \gg P(\text{injury} | W)$ then it's required that $P(P) \gg P(W)$

that is, probability that the chosen sled was P is much greater than probability that the chosen sled was W .

$$\text{Total injuries} = n_p + n_w$$

According to you, $n_w = Km + n$

m = number of times multiple people rode the sleds (wooden)

n = number of times 1 person rode wooden sleds

for your claim to hold, the author must say that the number of injuries due to plastic sleds is less than the number of injuries due to wooden sleds.

as for you, K has to be greater than n_p .

K has to be sufficiently large. The same cannot be said for m & n as $n_p > n_w$ is the assumption the author must make.

K has to have a reasonable upper limit, or else we will end up saying an unrealistic number of people rode wooden sleds.

$$\left. \begin{array}{l} n_w = (10)(4) + (5) \\ n_p = 9 \end{array} \right\} \text{equal \# of sleds.}$$

One simply does not have the time to think for more than 60 to 90 seconds on the exam for any given question. Therefore, the text and the instruction must determine some answer before one sees the options. The kind of proof these images show is deliberate thinking and this takes time. Also, as an exercise, validate this argument. Hint: it is only partially valid.

References and Further Reading

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- G. <https://www.euppublishing.com/doi/10.3366/film.2025.0300>