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Theory in academic research: Field differences in uses[1]

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Purpose: To explore new methods to gain some insights into how theory use varies between fields.
Design/methodology/approach: A triangulation of three muti-field partial studies of theory use. All studies use the full text of MDPI articles, a convenient science-wide source of clean article full texts, with the first analysing all large MDPI journals and the other two focusing on a multidisciplinary set of six. Study 1 used simple text matching of theory terms, and the others used large language models to extract theory-related information, also forcing them to name a "main theory" in each article.
Findings: Study 1 found large field differences in the extent to which theory is mentioned in MDPI journal articles, from "theory" rarely appearing in *Biology* and *Life Sciences Forum* (3%) to being common in *Administrative Sciences* (72%). The term "model" is more frequent, potentially signalling a theory informed approach or an attempt at generalisation. Study 2 found substantial field differences in the explicitness, centrality and effectiveness of the main theory used in articles, according to Gemma3, with stronger contributions tending to occur in higher quality articles. Study 3 found substantial field differences in the commonness of individual named theories, the explicitness with which theory is referenced, and the role that the main theory plays in articles.
Originality: Although based on a single publisher, this study suggests that explicit invocation of theory is not the norm in most academic fields but that it is more typically implicit and unnamed – part of the fabric of a field.
Practical implications: Researchers should be sensitive to field differences in theory use, in case expectations learned from their home field are inappropriate elsewhere.
Keywords: Academic theory; Disciplines; Academic fields; Disciplinary differences; Large language models.

Introduction

Theories constitute an important building block of scientific progress because they help organize existing knowledge in a systematic manner by explaining 'how', 'why', and 'when' a phenomenon occurs (Nunkoo and Armbrecht, 2025). Even in practice-oriented disciplines such as operations management (e.g., Wacker, 1998) and nursing (e.g., Bond et al., 2011), theory is necessary for scientific rigor and improving practice. Scholars, reviewers and research evaluators sometimes need to take a perspective on the use of theory in a particular study, such as whether it is essential for it to be explicit and central or whether it is acceptable, or even preferable, for it to be implicit or absent. For example, an editor might desk reject a

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paper for lacking theory or a reviewer might require the incorporation of theory as a major revision. Whilst this decision might be straightforward for an experienced or well-read scholar for a standard study in a narrow field, more complex contexts can add difficulties. If theory is used differently between fields, then misunderstandings are likely in the interdisciplinary environment of modern research. Thus, it is important to understand how theory use differs systematically between fields.

From a broad context, science is typically thought of as cumulative, with researchers hypothesising about how the world works and testing their ideas through experimentation. The results build theories that encapsulate knowledge or plausible hypotheses. These sometimes have specific names, such as The Theory of Relativity or Hooke's Law, and scientists vary in the extent to which they are theory driven (Simonton, 2006). This academic style is not universal, however, with knowledge in the humanities not being cumulative; argumentation and intertextuality are a partial replacement. Also, in engineering, technical knowledge of what works is perhaps only loosely theory related. In pure mathematics, the entire subject is about theory in the sense of theorems about abstract symbolic manipulations even though a social scientist might not recognise this as theory. In the social sciences, studies are often specific to a location or context, and theory plays the role of generalisation rather than universalisation, as discussed below. Despite these known differences, there does not seem to have been a systematic comparison of theory use between fields. One previous study has attempted to extract mentions of theory or models from social and behavioural science papers using Wikipedia for a list of theories, but it used a loose definition of theory (e.g., including confirmation bias) and only included one broad field (Wei et al., 2022). A smaller scale study used scientometric methods to map the relationships between eight pre-selected theoretical orientations within cognitive science (Contreras Kallens and Dale, 2018). The absence of broad level theory studies might be due to the difficulties of manually identifying theory use for a large enough sample of articles, and the lack of comprehensive easily accessible full text collections of articles from across all academic fields, both of which issues have suggested solutions in the current article.

This paper investigates field differences in theory use across a wide range of academic fields with a triangulation approach: three studies with different methods and goals providing alternative perspectives. The problem of a lack of complete science-wide collections of full text articles is addressed by using the full text XML of MDPI journals, which seem to span all of science. The problem of the time-consuming nature of extracting information about theory use in articles is addressed by using the Large Language Model (LLM) Gemma3 27b, with partial manual checking of, and reflection on, the results. The studies and research questions are opportunistic in the sense of addressing not the core issues but related phenomena that are possible to investigate with the data and methods available. Since LLMs are too expensive to use on all articles, fully science-wide issues are addressed with simple text matching instead, grouped into Study 1. This investigates mentions of the terms "theory" and "model" (as an alternative way of sometimes encapsulating theory: Wei et al., 2022) in all large MPDI journals.

- Study 1, RQ1: How large are the field differences in the explicit mentioning of theory and models in journal articles, and in which fields are they most and least common?

The second study takes a deeper approach by identifying theory use in journal articles, rather than just mentions of theory-related terms. It attempts to investigate, for a small multidisciplinary sample of journals, the explicitness (in the article), effectiveness (in supporting the research), and centrality (to the article) of the main theories in journal articles.

Ultimately, the most important aspect of theory use is its effectiveness, so it is helpful to know whether this is related to its explicitness or centrality in an article (RQ3).

- Study 2, RQ2: How large are the field differences in the explicitness, effectiveness, and centrality of named theory use in journal articles?
- Study 2, RQ3: Is theory use more effective when it is more explicit or more central to an article?

The third study investigates how theory is used and how prominent individual theories are. This takes a much wider perspective than the first by incorporating (with the help of an LLM) theory use that is implicit as well as investigating a range of different possible uses. The final research question is important because some fields seem to have particularly dominant individual theories so it would be useful to know how common this phenomenon is.

- Study 3, RQ4: How is academic theory typically used in published journal articles, and what are the differences between fields?
- Study 3, RQ5: Are individual-named theories more dominant in some fields than others?

Academic Theory

Whilst the importance of theory in academic research is widely recognised, the meaning of the word is contested and there are many closely related terms, such as paradigm, theoretical framework, conceptual underpinning and theoretical basis. Broadly speaking, however, a theory is a statement of concepts and their interrelationships that shows how and/or why a phenomenon occurs (cf. Gioia and Pitre, 1990). Theories allow researchers to explain or predict a phenomenon or describe and explain a process or sequence of events (Corley and Gioia, 2011). In so doing, they advance a discipline by providing its research with cohesion, efficiency and structure (Reay and Whetten, 2011). However, theory is used and named differently both within and across disciplines, depending on their philosophical traditions. This section discusses the concept with reference to differences in the epistemological foundations between disciplines. There is no empirical overview of theory use across academia, although many papers have noticed substantial disciplinary differences in loosely related factors, such as the use of references (e.g., Jaffe, 2014).

The division of academic fields into 'natural science', 'social sciences', and the 'humanities' is well established, although the basis of this distinction is not widely agreed (Wierzbicka, 2011). At least epistemologically (i.e., how knowledge is acquired), these disciplines differ because "the nature of the object influences the nature of the scientific knowledge" (Popov and Chompalov, 2015, p. 32) and what we take that object to be influences the way we study it (Pratt, 1978). It is therefore not surprising that because the object of study varies across disciplines, the nature of theory and its function also differ (Flyvbjerg, 2001).

Natural sciences

In the natural sciences (at least from the realist philosophical perspective), the objects are conceived as real and well defined rather than mentally and socially constructed. The objects of study can be broken down into measurable components, and the researcher maintains objectivity in the research process by remaining detached from the object so as not to influence the measurement (Popov and Chompalov, 2015). Theories in the natural sciences, tend to be general/abstract and about universal laws in nature, such as the theory of relativity and Newton's Laws of Motion. They are deductive and are typically able to make predictions;

these can be converted into hypotheses and tested empirically (Morgan and Morrison, 1999; Vetterling, 1973).

Engineering and applied sciences

In engineering and applied sciences, while the epistemological principle of objectivity still applies (Popov and Chompalov, 2015), the goal is not only to explain nature but to solve practical problems and theory is drawn on to help design solutions (Boon, 2020; Zwart, 2022). Thus, theory in engineering is typically implicit and often used to inform the research design of a study. In this context, a useful theory is one that helps to design effective solutions. Constructal theory (Bejan, 1996), for example, has been used to study heat and mass transfer in engineered systems and inanimate flow structures such as river basins (Reis, 2006). Rocha et al. (2017) use the constructal design method based on constructal theory, itself based on the constructal law, to study heat transfer. Likewise, control theory is used to analyse flight stability in aircrafts, rather than to predict a phenomenon or test an a priori postulate (Stengel and Broussard, 1977).

Social sciences

In the social sciences, the objects of study are more diffused and dynamic and can be conceptualized as both objective and well-defined or socially constructed, depending on the scale of social reality (Popov and Chompalov, 2015). The social sciences are not characterized by one fundamental class of object, but two (or possibly more) scales: the small scale and the large scale of reality, which have completely different properties and 'behaviour', with implications for theory usage. Macro-economics as a social science field provides an example of a large scale of social reality. Macro-economists may apply the principles of the natural sciences to study the workings of the economy (e.g., economic forecasting) where the system functions as a natural object, characterized by limited human influence. The Solow economic growth theory, for example, is used to predict long-term economic growth from capital accumulation, population growth, and technological progress (Solow, 1956).

Small scale social studies, on the other hand, involve the study of small groups and individuals whose actions and behaviours are socially constructed. Each individual or group becomes an entity of its own that deserves to be studied from multiple perspectives (Popov and Chompalov, 2015). Here, social science research involves the study of meaning, and theories are used to help explain social patterns and behaviours, although what counts as a theory is contested (e.g., Sutton and Staw, 1995; Weik, 1995). There are often multiple theories that can be applied to the same situation, and they help to select the concepts to include and the research questions to investigate. Social science theory here provides "mid-level" abstraction (Merton, 1968) that often helps researchers to generalise beyond the specific case investigated and to add insights from their case to existing theories, perhaps refining them (Yin, 2018). Academic fields in social science are diverse, however, with some such as management, tourism, sociology and psychology involving the study of both (hypothesised) objective truths and socially constructed realities depending on the philosophical position of the researcher. Consequently, theories are used both deductively and inductively, depending on the nature and purpose of the study. Stroh et al.'s (2017) research, for example, tests agency theory to predict compensation strategies for middle-level managers while Goolaup and Nunkoo (2023) use Turner's structure and anti-structure theory inductively to study consumers' extraordinary experiences.

Theories seem to have been repeatedly discussed and categorised within the social sciences, where their role is perhaps most contested. A brief overview is therefore given here. An analysis of theory uses in information systems research identified five types in terms of their purposes: analysing, explaining, predicting, explaining and predicting, and design/action. With this scheme, two thirds of 50 journal articles analysed used explanation and prediction theory (Gregor, 2006). In contrast, an investigation into theory uses for health professional education research distinguished between theory, theoretical frameworks, and conceptual frameworks. Researchers in this field often used indictive theory development, theory-informed data analysis, and theory-informing data analysis (Varpio et al., 2020). Another scheme, developed from 246 management research articles, identified three dimensions of variation: general vs. middle-range theory, contributions to theory vs. contributions of theory, and cause-focused vs. effect-focused propositions (Whetten et al., 2014).

Theory can also be used to provide a rationale for a social science study or the research questions (Stewart and Klein, 2016). Not all articles use theory, however, with a study of library and information science finding that only 41% contributed to its development or use (Kim and Jeong, 2006). Within management and organisation research, Chinese-authored research seems to frequently add a Chinese context to interpret a theory, however, therefore expanding theories or challenging them (Jia et al., 2012).

The Humanities

The humanities provide a contrasting example of theory usage to the natural sciences and social sciences. The concept of 'humanities' has its etymology in the works of early philosophers such as Hans-Georg Gadamer, Jacques Derrida, and Micheal Foucault, and is largely interpretive (Popov and Chompalov, 2015). While the social sciences and natural sciences study the conscious production of the social world and the study the physical and natural world, respectively, the humanities evoke a field of inquiry that studies human experiences, focusing on the production of meaning and the reconstruction of this process (Popov and Chompalov, 2015; Wierzbicka, 2011). Thus, 'people' becomes the subject matter of the humanities. Humanists argue that 'people' cannot be studied in the same way as 'things' are studied in the natural and applied sciences (Wierzbicka, 2011). The humanities, therefore, has its own goals and methods. Research in the humanities does not attempt to explain or predict but aims at understanding by establishing empathetic connection with the object of the study, without any attempt to generalize meanings inherent to the individual to outside situations.

There are no theories in the humanities if 'theory' is defined from a rationalist paradigm as in the natural sciences. Instead, research in the humanities uses theory very loosely, and draws on existing 'paradigms', 'discourses', or 'grand narratives' such as Marxism postcolonialism, and feminism, as interpretive lenses. Theory often provides a perspective or reading strategy from which to decode text or interpret the object of study (Jacobs, 2013). In contrast to common social science applications, it is not necessary to demonstrate that the theory chosen is the "best" one, only that it yields useful interpretations. For example, a feminist reading of a novel might yield very different results to a Marxist interpretation of it: Hoskin and Blair (2024) use femme theory based on feminist thought to analyse how femininity is constructed and represented in popular culture.

Interdisciplinary research

Interdisciplinarity comes with its own interpretation and usage of theory (CohenMiller and Pate, 2019). In interdisciplinary fields, the use of theory might combine social sciences and applied sciences approaches (Gibbons et al., 1994; Repko and Szostak, 2020). In addition, theory might be used to justify the academic credentials of a study in a relatively new area for publication purposes. The challenge, however, is that there are no clear understandings and established norms of theory in interdisciplinary research because of the absence of a common language: a lack of shared syntax, semantics, and pragmatics, makes it difficult for editors and reviewers to evaluate such studies (Carlile, 2004). It is probably for these reasons that interdisciplinary research has been criticized for insufficient theorising (Reinecke et al., 2024). More concretely, in the interdisciplinary field of scientometrics, there have been calls for an explicit citation theory to guide citation analysis studies (Leydesdorff, 1998), but this has failed, with scientometricians instead citing a range of types of empirical evidence and argumentation to support their methods and interpretations (e.g., Moed, 2005). A systems thinking approach to theoretical framing is often recommended in interdisciplinary studies. While acknowledging that theory can be illusive in interdisciplinary research, a "theoretical framework can be thought of as a purposeful identification of theories across disciplines, an orientation which provides guiding perspectives for research and practice" (CohenMiller and Pate, 2019, p. 1214). Adger's (2003) study, for example, integrates perspectives from various disciplines and uses the social capital theory to study collective action and adaption to climate change.

From the above perspectives, the current article does not use an explicit theory but is primarily descriptive. Nevertheless, it works within a social constructivist paradigm, in the sense of starting from the premise that a "theory" is what academics consider one to be. It also draws upon prior academic knowledge about how to query LLMs and academic discussions about the difference between paradigms, theories and fields. The closest thing that it has to a "main theory" might therefore be said to be implicitly the social constructivism paradigm, but this is a theoretical orientation rather than a theory. There is a theory called social constructivism, but this has a very different educational research meaning.

Methods

The research design was to obtain a large multidisciplinary set of journal articles and then use text matching or LLMs to extract theory-related information from them to address the research questions. Despite being an article about theory, it is not informed by any named theory but has a humanities style approach in the sense of primarily getting an LLM perspective to support a discussion of theory use in academia.

Large MDPI journals dataset

The XML full text archive of the publisher MDPI was used as the raw data for this article. In December 2025, MDPI's 471 journals seemed to cover all academic research areas (although not in 1-1 correspondence with any science-wide field categorisation scheme), so are a reasonable choice. Other full text archives are less useful. For example, the PLoS journals have full text availability but do not seem to have good coverage of the social sciences, arts and humanities, even within PLoS One. The huge PubMed Central open access collection is primarily of biomedical research. Open access collections culled from the web, such as

core.ac.uk, typically rely on PDFs, which are difficult to reliably parse on a large scale – especially since some are preprints or have watermarks - and have unknown sampling bias.

The MDPI journal collection also has problems: these journals seem to be more interdisciplinary than the journals of most other publishers, which is a disadvantage for identifying field differences. Moreover, the provenance of the collection is unknown in the sense of publisher decisions to create or acquire the individual journals within the portfolio, so there may be unknown coverage biases and gaps. Nevertheless, its apparently science-wide coverage makes it preferable to other sources. The other major open access science wide full text publisher, Frontiers, would probably have similar properties to MDPI but does not have clear advantages for the purpose of the current project.

XML copies of all MDPI journals were downloaded from MDPI's FTP server, with MDPI's permission, on the 19th of December 2025. They were parsed with a Python program to convert them to plain text files containing the title, abstract and article main text, but excluding the references to avoid getting irrelevant text matches from the reference list. All metadata was excluded, such as author names, affiliations and acknowledgments, as well as the journal name. Figures were not included. Only larger journals were retained for analysis, with 1000 selected as the minimum number of articles for a journal to be included, with one exception explained below. The purpose of excluding smaller journals was to focus on journals with enough articles that the proportion mentioning theory could be estimated without very wide confidence limits. This allows clearer graphs of the results. 1000 was chosen heuristically in advance as a large round number in the absence of prior estimates of likely proportions of required confidence widths that would have allowed a statistical power calculation for minimum sample sizes.

Six MDPI journals from different fields dataset

For the LLM analyses of studies 2 and 3, five large MDPI journals were selected to span different types of discipline. No systematic method for theory selection could be devised so they were selected heuristically by the first author in the belief that they broadly represented different types of academic field (in the widest sense), apart from the last one.

- *Humanities*: This is the logical choice to represent the humanities and is also included to cover the arts since there is an overlap and no large arts-focused journal.
- *Social Science*: This is the logical choice to represent the social sciences. Although there are many narrower social science journals, a generalist journal is a safeguard against any results being due to the specificities of an individual field.
- *Sustainability*: This was included to represent engineering and applied sciences. It is not an ideal choice because it includes some social science from geography and environmental science, it is a very large journal and seems to include a wide range of types of applied science and engineering research. There did not seem to be a clearly better alternative, and this journal is very large so perhaps has additional interest from this perspective.
- *Molecules*: This represents a relatively pure science field. The journal is specialist but represents a large and important topic.
- *Healthcare*: This represents the health sciences. Although it has a general title, it does not seem to include much medical research.
- *Tourism and Hospitality*: This social science journal was added because one of the authors is an expert on theory use in this field and so its analysis might be particularly insightful.

For journals with over 5000 articles, a random number generator was used to select 5,000 articles to give a manageable sample size. The exceptions were: *Humanities* (1217); *Social Science* (4302); and *Tourism and Hospitality* (423).

Study 1 methods: Journal variations in theory mentioning style

For study 1 the goal was to get a broad overview of the extent of variation in explicit mentions of theory. For this the full text of all large MDPI journals was scanned for the term "theory" or the alternative term "model" (Wei et al., 2022) and the distribution of proportions calculated and compared. A similar comparison was made for the contrasting term "hypothesis" for context. As mentioned above, large journals were selected so that the results could not be greatly influenced by random factors, with 1000 set heuristically as appropriately large.

The term "theory" suggests, but does not prove, that an article mentions academic theory although it can sometimes mean the opposite of theory, as in "grounded theory". This simplistic approach allows all the texts to be processed, although the results should be treated cautiously. Research can discuss models as a way of encapsulating abstract theoretical information, so the term "model" was used to capture other approaches to incorporating theory. The term "hypothesis" was added to cover an alternative way of mentioning more abstract contributions, since a hypothesis implies some background expectation, irrespective of whether a theory has been invoked.

Study 2: Journal variations in theory effectiveness, centrality, and explicitness

The second study aimed to gain insights into disciplinary variations in the use of theory at a deeper level than just assessing the frequency of relevant terms. A previously used theory extraction approach required thousands of human-annotated sentences for each field (Wei et al., 2022), so is impractical for science-wide analyses. Instead, information about theory use in the full text of articles was extracted with a LLM. Whilst this process would be better with field experts, testing showed that this task was very slow, difficult and error prone. For example, some articles mentioned their theory component in unexpected places and only once, so each paper would need to be read in entirety to get reliable information. Thus, expert processing would be impractical and LLMs were used instead.

The LLM Gemma3 27b was selected because it has given good results on document processing tasks and is much faster than reasoning LLMs with similar performances (Thelwall, 2025, 2026). An offline open weights LLM was used in preference to a cloud-based version because the advantage of larger cloud-based models seems insufficient to justify the additional cost in this case, where full texts are processed. The prompt below was designed after testing with variants to give useful information in a structured format that was consistently adhered to by the LLM. For example, a previous version of the prompt had asked for separate justifications for each numerical score, but this led to many incorrectly formatted answers and so seemed to be too confusing for Gemma3. The first two questions were included to set the context for the next three questions, which are the main ones analysed. The final question was included to allow manual checking of the results.

The most consequential decision from an interpretation perspective was the wording of the second question, asking for the name of the article's "main theory" without giving an explicit caveat, such as "if any". From the literature review above, many articles would not have an explicit or even, arguably, implicit, theory contribution. Nevertheless, the LLMs

frequently refused to give a main theory, as the following Gemma3 responses from *Tourism and Hospitality* illustrate.

- Not Applicable.
- Not explicitly stated, but utilizes principles of tourism economics and potentially service quality/patient satisfaction frameworks.
- The paper doesn't explicitly rely on *one* central theory. It draws upon a combination of concepts from sustainable tourism, innovation studies, and regional development theories. These concepts are integrated to understand how innovation can drive the development of rural green tourism.

The reason for not explicitly stating in the prompt that the LLM might not find a main theory was to give it the strongest encouragement to return implicit theories, helping a fairer comparison between journals mainly containing implicit or explicit theories. Nevertheless, this had the side-effect of producing things that are not theories as answers.

> Answer the following questions about the theoretical dimensions of the journal article below giving your answers strictly in the specified format without explanations.
> How does this paper use academic theory?:
> **What is the main theory** used in the paper to inform the analysis?:
> **How effectively does the article use this academic theory** (0-10)?:
> How **central is this academic theory** to the article (0-10)?:
> How **explicitly does the article describe this theory as a theory (0-10)?**:
> Justify the answers above:
> [article text]

The answers were systematically extracted with a Python program designed for the task. This worked nearly all the time, except that in a few cases Gemma3 gave a reason why the question could not be answered, such as because the article was of the wrong type. The scores were analysed as the primary data, and a sample of the explanations in the section at the end (or in explanatory text after the scores in some cases) were manually checked to understand the score rationales.

To obtain a relatively independent indicator of the quality of the journal articles, Gemma2 27b was also prompted to score all the articles for research quality at least five times, with the mean of these five scored used as an estimate of the article's quality. The article's title and abstract were entered for the score rather than its full text for two reasons: first, this approach gives better results (Thelwall and Mohammadi, 2026) and it reduces the chance that the score is unduly influenced by theory discussions in the article.

Study 3: Journal variations in major theories used

The third study aimed for insights into field differences in the extent of (a) named theory use (b) the role of theory in papers. Gemma3 was used again for the same reasons and, after experimenting with different prompts on another dataset, the following was used to extract information for the research questions. Again, no option was given to not name a theory to encourage implicit theory to be mentioned.

> Answer the following questions about the theoretical dimensions of the journal article below giving your answers in the specified format.
> Name the main theory used in the paper to inform the analysis. Just give the name without any explanation:___
> Justify your choice of the theory named above:___
> Extract a sentence from the paper that mentions the theory named above:___

Explain how the paper uses the theory mentioned above:___
Critically evaluate how effectively the paper uses the theory named above:___
Give a score out of 10 for how effectively the paper uses the academic theory named above where 0 = very poor and 10 = Extremely useful and insightful:___
[article text]

The main purpose of this prompt was to get the name of the main theory used in each article. The additional questions were included because initial prompt testing showed that the theories mentioned were often clearly not theories and so extra context was needed to assess the results. For this study (only) the above prompt was sent five times (non-consecutively, although this should not have made a difference) to assess whether Gemma3's answers varied to any great extent, and if this differed between fields. Answer variation suggests a degree of model uncertainty about the answer, which may reflect a paper not clearly using a given theory.

Manual checking of the results confirmed that many "theories" had been mistakenly characterised as such by Gemma3. Thus, a follow-up test was run to categorise the theories extracted by their likely common function. Again, because of the large number of theory names and the difficulty in obtaining unbiased expert human judgements about the nature of theories in diverse fields, a LLM was asked for the role of each identified field. For this, ChatGPT-4.1 mini was used, as a more powerful LLM and different from Gemma3 to increase the chance of independent results.

Could the term "[name]" in an academic journal article in [field of journal] refer to:
A research paradigm (yes/no): __
A theoretical perspective (yes/no): __
An academic theory (yes/no): __
A research field (yes/no): __
A research method (yes/no): __
Something else (list): __
Which of the above is it most likely to refer to?: __
Just answer the questions without any explanation.

The above query was submitted in December 2025 and January 2026 to ChatGPT-4.1 mini through its Applications Programming Interface, with a different session for each prompt.

Results

Study 1: Journal variations in the use of theory-associated terms

Overall, there are huge differences between large MDPI journals in the proportion of articles mentioning the term theory (Figure 1), from a minimum of 3% (*Biology and Life Sciences Forum*) to a maximum of 72% (*Administrative Sciences*). In general, the term is rare in life sciences journals but more common in journals that tend towards pure maths (e.g., *Fractal and Fractional, Axioms*), finance (e.g., *International Journal of Financial Studies, Journal of Risk and Financial Management*) and theoretical physics (e.g., *Universe, Entropy*). Social sciences journals also tend to have a high proportion of theory mentions: *Behavioral Sciences* (61%), *Education* (60%), *Economies* (58%), *Societies* (56%) and *Social Sciences* (55%). Theory is slightly less common in the humanities, as evidenced by *Humanities* (55%), *Religions* (52%), *Arts* (46%), and *Languages* (46%). In contrast, theory is mentioned in a minority of articles but still moderately often in most applied and engineering journals, such as *Aerospace* (40%), *Remote Sensing* (21%) and *Water* (20%).

There are also large differences in the proportions of articles mentioning "model" and the contrasting term "hypothesis" (Figure 1). The term "model" seems to be more widely used, with most articles in almost all journals containing it. High use journals included those from engineering (e.g., *Aerospace, Drones*: 96%) and financial journals (e.g., *International Journal of Financial Studies*: 97%). In contrast, medical and health journals had lower levels of use (e.g., *Clinical Practice*: 37%, *Antibiotics*: 55%).

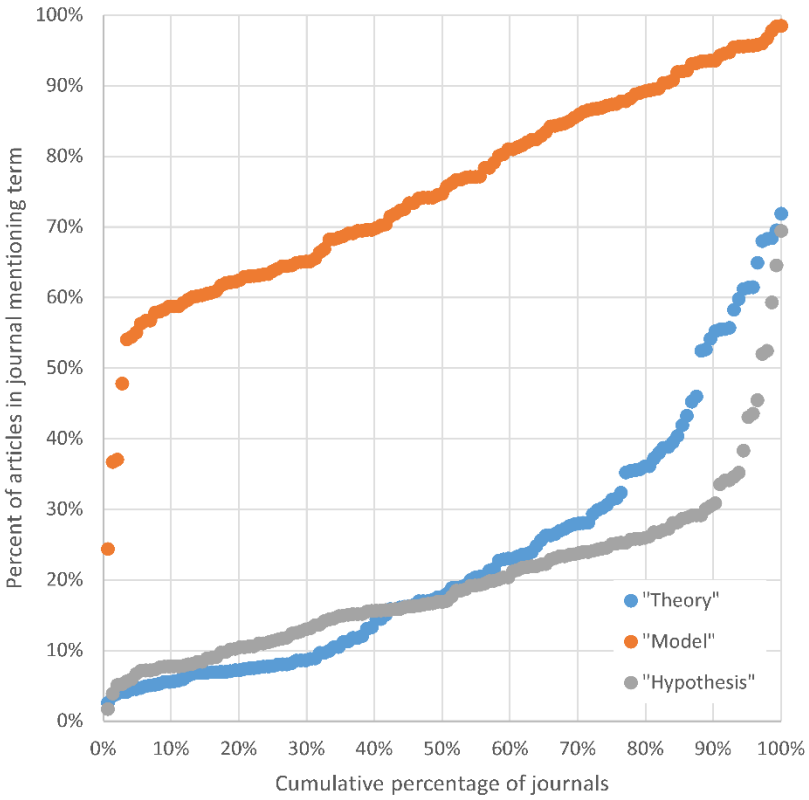


Figure 1. Cumulative proportion of large MDPI journals (i.e., with at least 1000 articles) by percentage of articles containing the terms "theory", "model" or "hypothesis".

There was a moderately strong correlation between the proportions of articles containing "theory" and "model" for large journals (Pearson's r=0.505) (Figure 2). Thus, thus there was a moderate tendency for the two terms to be more used by the same journals. The exceptions were journals where theory was rarely mentioned but models were common, which seemed to be on biomedical topics, such as *Metabolites* (Theory: 7%; Model: 80%), *Cancers* (Theory: 6%; Model: 78%), and *Biomedicines* (Theory: 8%; Model: 82%). There were no opposite exceptions, but minor outliers were from the humanities, including *Humanities* (Theory: 55%; Model: 63%) and *Religions* (Theory: 52%; Model: 65%).

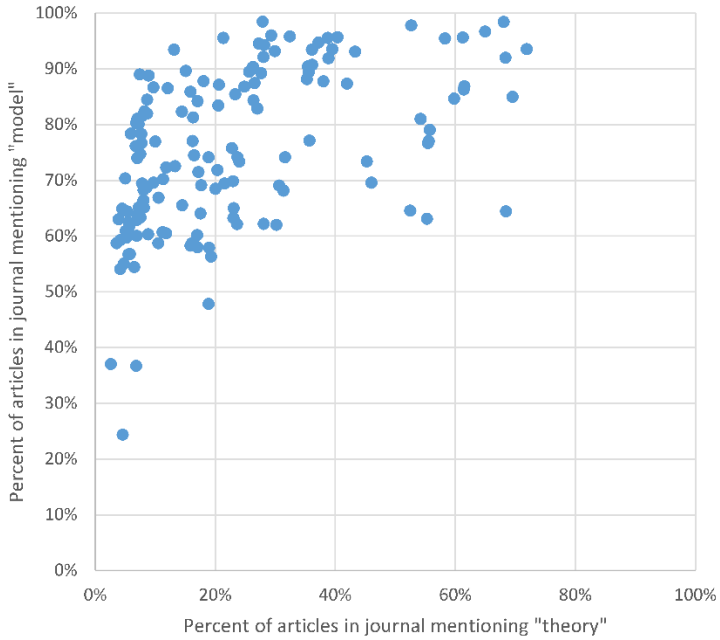


Figure 2. Percentage of articles containing the term “model” against the percentage of articles containing the term “theory” for large MDPI journals (i.e., with at least 1000 articles).

Study 2: Journal variations in theory effectiveness, centrality, and explicitness

As shown below for Study 3, the “main theory” extracted by Gemma3 was often not a theory but could also be a theoretical framework, research paradigm, field, method or something else. Thus, whilst the prompt for Study 2 was about theories, the results collectively probably more closely represent the main theoretical background of the articles. Here, the term “theoretical background” encompasses theoretical contributions encoded into fields and methods.

There were substantial differences between journals in the scores for “main theory” effectiveness given by Gemma3 (Figure 3). Whilst only three maximum scores of 10/10 were given (all for *Molecules* articles), over two thirds of *Humanities* articles scored 9/10 in contrast to only 16% for *Healthcare*. Example justifications from *Humanities, Healthcare*, and *Molecules*, respectively (the last two illustrating that not all “main theories” are theories), are:

- 9/10 - The application of trauma theory is comprehensive and nuanced. The paper consistently connects filmic elements to established concepts within the field (e.g., Caruth's work on traumatic repetition, Leys on mimetic processes). It demonstrates a strong understanding of both the theoretical framework and the film being analyzed.
- 3/10 - The use of theoretical framework is minimal. While the paper implicitly touches upon technology acceptance, it doesn’t actively *use* it to analyze the findings or interpret the trends in the literature. It’s more of an observational review than a theoretically driven analysis.
- **Effectiveness (10):** The review comprehensively demonstrates the application of coordination chemistry and asymmetric catalysis principles to the discussed reactions. It details mechanisms, ligand effects, and how theoretical understanding drives experimental design.

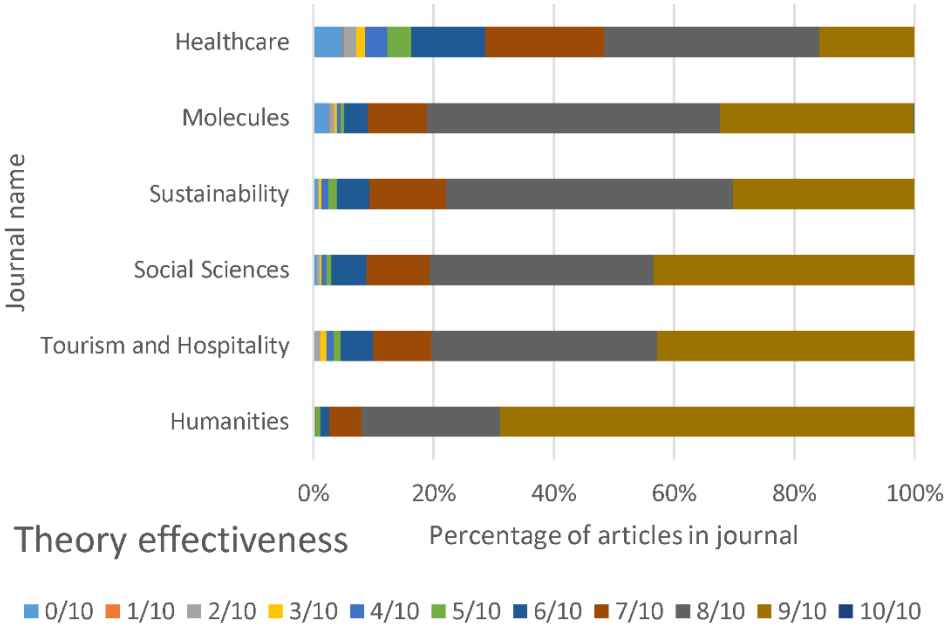


Figure 3. Gemma3 scores for explicitness of main theory (as extracted by Gemma3) use in a sample of up to 5000 articles in five MDPI journals.

There were similarly substantial differences in Gemma3's "main theory" (i.e., theoretical background) centrality scores between journals (Figure 4). In contrast to the previous case, there were many maximum scores for theory centrality, varying from 65% (*Humanities*) to 29% (*Healthcare*). Gemma3 may have been more cautious about the first question because it contains a stronger element of subjective evaluation. Example justifications from *Humanities, Sustainability*, and *Healthcare*, respectively, follow, with the last two again confirming that not all "main theories" are theories.

- 10/10 – Creolization is absolutely central. The entire argument revolves around it – the nature of folklore, the methodology of its study, its relationship to other disciplines, and its potential for intellectual innovation. The paper explicitly positions creolization as a key to understanding and *defining* folkloristics.
- 9/10. The theoretical framework is absolutely central to the entire article. The proposed model is *built upon* and *justified* by the principles of sustainable supply chain management and community-based development. Without this theoretical grounding, the paper would be merely a descriptive overview of Agro-Food Hubs.
- 3/10. The study is primarily empirical. While theory informs the discussion of results, the methodology and core findings don't *depend* on a specific theoretical framework.

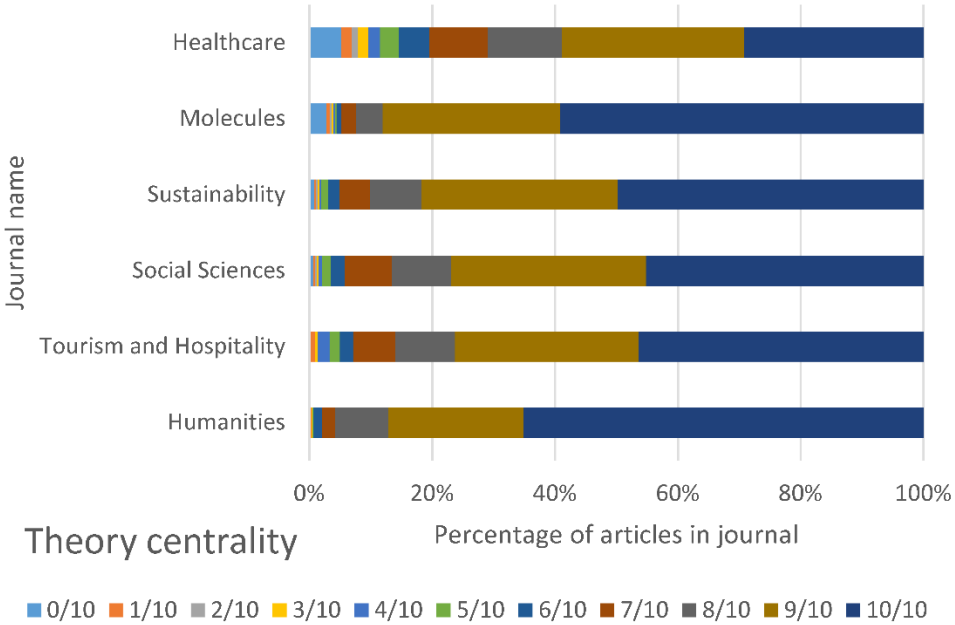


Figure 4. Gemma3 scores for the centrality of the main theory (as extracted by Gemma3) in a sample of up to 5000 articles in five MDPI journals.

A similar pattern of Gemma3 “main theory” explicitness score journal differences occurred (Figure 5), although few articles (24) scored 9 and none scored 10. It is not clear why no score of 10 was given since this seems like a straightforward question. Example justifications from *Tourism and Hospitality, Social Sciences, Sustainability* and *Molecules*, respectively, follow. These suggest that more theory description and critique would be needed to attain a higher score.

- 8/10. The article explicitly describes collaborative governance as a theoretical framework, referencing key authors (Ansell & Gash) and outlining core concepts. However, some of the discussions assume a baseline familiarity with the theory.
- 7/10 – While the article consistently *uses* the theoretical framework, the explicit *description* of the theory itself, particularly "Invisibilization," could be more formalized. The author outlines the concept but doesn't fully articulate its theoretical lineage or position it within broader theoretical debates as rigorously as might be expected.
- 6/10. While the article frequently *uses* theoretical concepts, it doesn't always explicitly *define* or *discuss* them *as* theories. It often integrates theoretical concepts into the discussion without specifically stating, “This concept is derived from X theory.” It names key concepts (CSR, Sustainable Supply Chain Management) but doesn’t always fully unpack their theoretical underpinnings.
- 4 - The article doesn’t explicitly *state* a theory with a formal description. It assumes a baseline understanding of these principles by the reader and integrates them within the introduction and discussion sections, referencing previous studies. The theoretical basis is embedded within the scientific reasoning, rather than explicitly articulated.

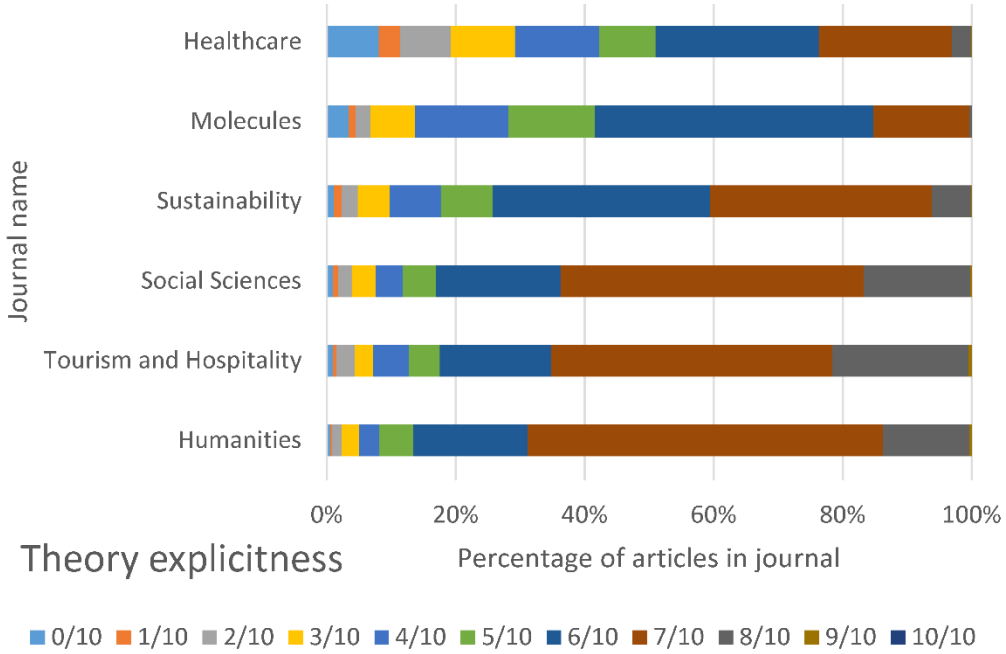


Figure 5. Gemma3 scores for explicitness of theory (as extracted by Gemma3) use in a sample of up to 5000 articles in five MDPI journals.

Average Gemma3 article scores are perhaps less informative than score distributions, but they highlight that *Healthcare* has the lowest scores for all three criteria and that the biggest differences are in (main) theory explicitness (Figure 6).

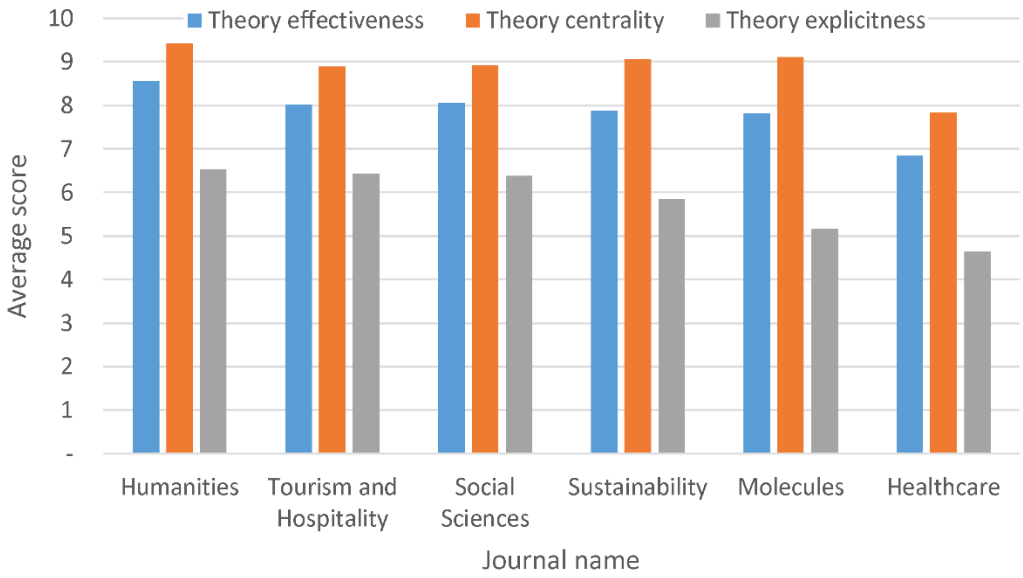


Figure 6. Average Gemma3 scores for three aspects of main theory (as extracted by Gemma3) use in a sample of up to 5000 articles in five MDPI journals.

In all journals, the more central and explicit a "main theory" (as extracted by Gemma3) is for an article, the more effective it is judged to be by Gemma3 (Table 1). The journal with the weakest connection is *Molecules*, perhaps because theory is implicit in the modelling used. More explicit theories also tend to be judged more central, with *Molecules* again having the weakest connection.

Table 1. Pearson correlations between Gemma3 estimates of the centrality, effectiveness and explicitness of the main theory in articles with an identified "main theory" as extracted by Gemma3.

Journal	**Articles**	**Effectiveness vs. centrality**	**Effectiveness vs. explicitness**	**Centrality vs explicitness**
Humanities	1180	0.720	0.710	0.508
Tourism and Hospitality	411	0.827	0.859	0.757
Social Sciences	4190	0.808	0.807	0.666
Sustainability	4812	0.790	0.763	0.559
Molecules	4604	0.751	0.641	0.361
Healthcare	4368	0.854	0.769	0.554

For all six journals, there was a weak positive correlation between the quality of articles, as judged by Gemma3, and the effectiveness, centrality and explicitness of their main theory, also as extracted and judged by Gemma3 (Table 2). Thus, more and better theory seems to improve research quality for Gemma3.

Table 2. Pearson correlations between Gemma3 quality estimates and Gemma3 estimates of the centrality, effectiveness and explicitness of theory in articles with an identified main theory.

Journal	**Articles**	**Effectiveness**	**Centrality**	**Explicitness**
Humanities	1180	0.330	0.229	0.239
Tourism and Hospitality	411	0.385	0.288	0.345
Social Sciences	4190	0.370	0.272	0.309
Sustainability	4812	0.330	0.218	0.273
Molecules	4604	0.224	0.141	0.270
Healthcare	4368	0.297	0.235	0.293
Average	-	**0.323**	**0.231**	**0.288**

Study 3: Journal variations in major theories used

The "main theory" identified in an article by Gemma3 was not always called a theory (e.g., Health Belief Model), and varied from relatively specific (e.g., Social Determinants of Health) to general (e.g., Systems Thinking) (Table 3). In a few cases, the "theory" was clearly a method (e.g., Machine Learning). In addition, the named theory was often not mentioned in the article (e.g., Systems Theory in *Healthcare,* Systems Thinking in *Sustainability*) but was presumably inferred from the context. No single theory dominated any journal: at most 5% of articles had the same main theory. There was only moderate variability in the estimated effectiveness of the identified main theory.

Table 3. The most commonly identified main theories in the six journals according to Gemma3: three theories per journal and additional theories if they seem interesting. Also reported is Gemma3's estimate of the effectiveness of the theory in the article, and the proportion of articles mentioning the theory name.

Journal	Theory*	Articles**	Effectiveness	In article
Healthcare	**Health Belief Model**	**249 (5.0%)**	**6.7**	**8%**
Healthcare	Social Cognitive Theory	175 (3.5%)	7.2	11%
Healthcare	Biopsychosocial Model	102 (2.0%)	7.7	21%
Healthcare	Technology Acceptance Model	94 (1.9%)	7.2	19%
Healthcare	Social Ecological Model	88 (1.8%)	7.5	2%
Healthcare	Social Determinants of Health	79 (1.6%)	7.9	39%
Healthcare	Machine Learning	52 (1.0%)	7.8	100%
Healthcare	Systems Theory	52 (1.0%)	7.6	2%
Molecules	**Structure-Activity Relationship**	**162 (3.2%)**	**7.8**	**35%**
Molecules	Density Functional Theory	139 (2.8%)	8.5	83%
Molecules	Molecular Docking	86 (1.7%)	7.9	97%
Sustainability	**Systems Theory**	**155 (3.1%)**	**7.8**	**6%**
Sustainability	Resource-Based View	92 (1.8%)	7.6	28%
Sustainability	Circular Economy	89 (1.8%)	7.8	94%
Sustainability	Theory of Planned Behavior	77 (1.5%)	7.8	83%
Sustainability	Sustainable Development	75 (1.5%)	7.8	99%
Sustainability	Life Cycle Assessment	73 (1.5%)	8.4	78%
Sustainability	Systems Thinking	69 (1.4%)	7.9	17%
Social Science	**Intersectionality**	**85 (2.0%)**	**8.5**	**78%**
Social Science	Social Constructionism	74 (1.7%)	8.2	4%
Social Science	Feminist Theory	66 (1.5%)	8.4	17%
Social Science	Social Identity Theory	63 (1.5%)	7.8	51%
Social Science	Social Learning Theory	63 (1.5%)	7.3	19%
Social Science	Critical Race Theory	55 (1.3%)	8.4	35%
Social Science	Social Cognitive Theory	52 (1.2%)	7.8	35%
Tourism	**Social Exchange Theory**	**15 (3.5%)**	**7.8**	**67%**
Tourism	Theory of Planned Behavior	14 (3.3%)	8.3	93%
Tourism	Resource-Based View	11 (2.6%)	7.3	27%
Humanities	**Postcolonial Theory**	**57 (4.7%)**	**8.4**	**12%**
Humanities	Psychoanalysis	28 (2.3%)	8.6	68%
Humanities	Feminist Theory	22 (1.8%)	8.5	9%

* Some "main theories" are not theories but may represent the main theoretical background
** The highest values for each journal are bold.

There were substantial differences between fields in nature of the "main theory" extracted from articles by Gemma3, at least according to ChatGPT's interpretation of the theory names (Figure 7). Whilst in *Tourism and Hospitality*, almost half of the main theories were apparently genuine academic theories, and over two thirds were theories or theoretical perspectives, the same was true for less than 20% of "main theories" in *Molecules*. *Humanities'* "main theories" were uniquely likely to be theoretical perspectives (53%), a concept that was almost absent from *Molecules* (0.7%; an exception was Food Systems Theory in the article "Development of

a Functional Cookie Formulated with Chaya (*Cnidoscolus aconitifolius (Mill*.) I.M. Johnst) and Amaranth (*Amaranthus cruentus*)", which seems out-of-topic for the journal).

In most cases for some journals the "main theory" was not a theory according to ChatGPT, so all the categories below other than the first three represent Gemma3 errors. This can be interpreted as either the article not containing or not strongly alluding to a theory or not mentioning it clearly enough for Gemma3 to easily notice. Thus, it seems reasonable to interpret Figure 7 as evidence of disciplinary differences in explicit theory use, and the nature of that theory, albeit weak evidence. Here are some examples to illustrate the six categories.

- **Academic theory**: Social Identity Theory in *Social Science* is a social science theory that predicts some group behaviours based on personal identities constructed through exploring differences between groups.
- **Theoretical perspective**: Postcolonial Theory in Humanities and Social Sciences relates to the topic and field of postcolonialism. It could be reasonably described as either a theory (loosely) or a theoretical perspective. The latter seems more precise because it is a framework from which to analyse events rather than to predict them.
- **Research paradigm**: Realism in *Social Science* is a general term that is used for multiple related purposes, including as a research paradigm or general theoretical framework. For example, in international relations, it refers to the perspective that states are self-interested actors within the international system. In philosophy, (philosophical) realism refers to the perspective that things exist independent of their perception by minds.
- **Research Field**: Phytochemistry in *Molecules* is the study of chemicals derived from plants: a field and topic rather than a theory.
- **Research Method**: Life Cycle Assessment in *Sustainability* is a methodology for assessing all the impacts within the lifecycle of a commercial product, service, or process.
- **Something else**: Gemma3 sometimes gave examples of the "something else", as classified by ChatGPT, although they were varied. In Healthcare, one case was Polycystic Ovary Syndrome, which ChatGPT correctly described as "A medical condition/disorder", despite Gemma3 extracting it from four Healthcare articles as their main theory. A similar example from three *Healthcare* articles was, "Proprioceptive Neuromuscular Facilitation", which ChatGPT described as "A therapeutic technique/intervention".

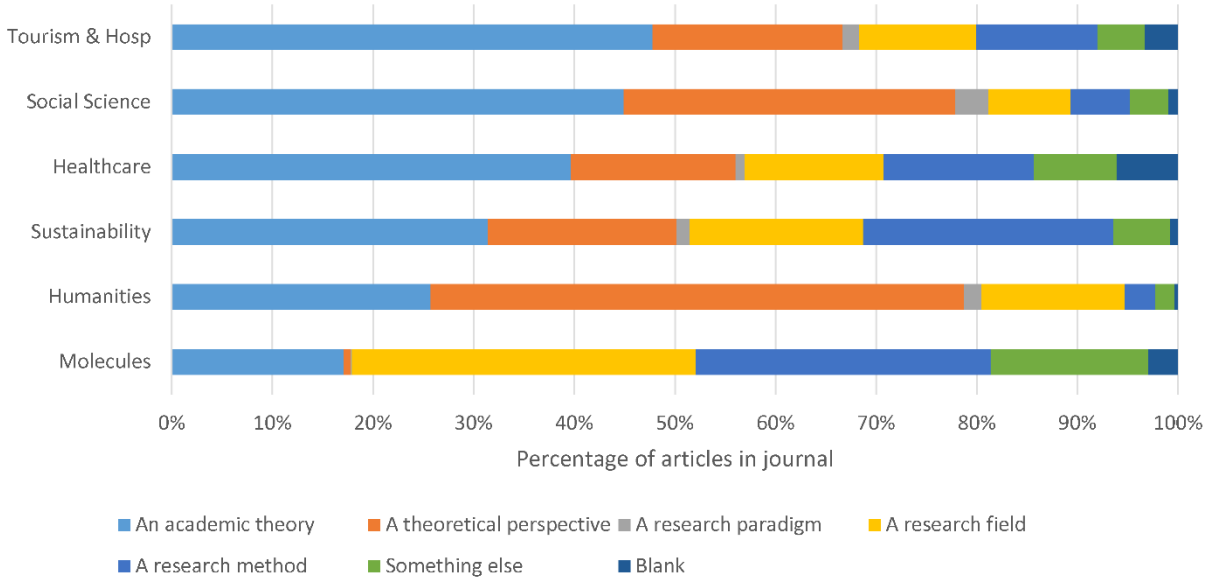


Figure 7. ChatGPT's characterisation of the type of the "main theory" extracted from an article by Gemma3.

Discussion

As mentioned at the start of the methods, the purpose of the LLM results is to give a perspective from which to discuss theory use in academic research rather than to provide scientific answers to the research questions. The LLM-based results are therefore exploratory and far from definitive. A particular limitation is that the "main theory" extracted for Study 2 and Study 3 was not necessarily a theory and was sometimes instead a method, field, or research paradigm, which adds substantial uncertainty to some interpretations of the results (see below). The research design was used despite its considerable weaknesses in some aspects, because LLMs make possible analyses that are impractical through more robust methods. In addition, the term matching approach is simplistic (e.g., the word "theory" does not always refer to an academic theory), and the LLM classifications are pattern matching guesses rather than accurate deductions. Moreover, the concept of academic theory has multiple overlapping meanings or definitions and there probably is not an academic consensus on whether many of the terms analysed are genuinely theories or not. Finally, the use of MDPI journals as a proxy for fields, as mentioned above, is only a very rough approximation since they mostly have a substantial degree of interdisciplinarity. Thus, the face validity strength of the evidence for the answers to the field difference aspects of the research questions is weaker than would be possible from purer field-based journals or collections of articles.

The above limitations undermine the strength of the evidence but do not render it invalid if some assumptions are made. For the pattern matching approach, it seems reasonable to assume that in most fields, articles discussing theory will tend to use the word "theory" more often than articles that don't so the exceptions (e.g., grounded theory) are "noise" that obscure the pattern. No single main method was mentioned often enough to substantially disrupt this overall pattern. Thus, the existence of large field differences in the explicit mentioning of theory seems evidenced, but not the exact degree of difference.

For the LLM predictions of theory centrality and explicitness, these are pattern matching guesses rather than reasoned deductions, but these two questions seem suitable for LLM pattern matching approach since they are about text usage rather than

understanding. Nevertheless, the answers are somewhat undermined by referring to the paper's "main theory", which was not a theory in most cases. It is harder to make a case for LLM judgment of theory effectiveness being credible, although Gemma3 27b is reasonably good at the related task of research quality assessment (Thelwall, 2025). Finally, ChatGPT's assignment of the most likely category for the main theories extracted by Gemma3 seems likely to be reasonably accurate given that it is good at classification tasks, but its results are undermined in some cases by polysemy in the sense of terms that could mean theory in one context and something else in another.

RQ1: How large are the field differences in the explicit mentioning of theory and models in journal articles, and in which fields are they most and least common?

The results suggest that there are large differences between fields in the explicitness of theory mentions, with some journals almost never mentioning the term theory and almost all articles in others mentioning it (Figure 1). This may reflect the roles of theory differing between broad disciplines, as mentioned in the literature review (e.g., Flyvbjerg, 2001). Nevertheless, it gives direct evidence that theory is not explicitly part of many fields but may perhaps be embedded into academic thinking more indirectly through models, hypotheses or other constructs, or omitted altogether.

From the perspective of Gemma3, the social sciences and humanities are the most explicit in named theory use (Figure 5), which seems reasonable since models and hypotheses may convey theory in other fields (e.g., Morgan and Morrison, 1999). Nevertheless, at least 48% of articles in the other three journals investigated score at least 6/10 for named theory explicitness (Figure 5). This contrasts with the low figures in Figure 1 and may be a side-effect of LLMs preferring high scores and may reflect a stretching of the boundaries of either "explicitness" or "theory" so is difficult to interpret.

RQ2: How large are the field differences in the explicitness, effectiveness, and centrality of named theory use in journal articles?

According to Gemma3, there are substantial differences between broad fields (journals) in the explicitness, effectiveness, and centrality of named main theory use (Figures 3, 4, 5), but recall that Gemma3's "main theory" could also be a research paradigm, field or method, so this result should be treated with particular caution. Strangely, Gemma3 considers theory use in *Humanities* to be the most effective overall (69% scoring 9/10 in Figure 3). This seems counterintuitive because theory in the humanities seems to play a weak role in the sense of giving a perspective rather than explanatory power (Popov and Chompalov, 2015). The high score may be an artefact of repetition of the theory throughout a humanities article so it may be more effective in the sense of guiding the writing and logic of the output rather than generating new knowledge. It is not clear why Gemma3 considers theory to be the least effective for *Healthcare*, however. The results are due to articles being relatively short and having less space for repetition of theory names. It seems more likely that this is more fundamental in the sense of reflecting the importance of finding healthcare interventions that are effective rather than building theory. The potential tension between the two goals has been previously noted (e.g., Prestwich et al., 2014)

The theory centrality results (Figure 4) broadly mirror the theory effectiveness results, adding evidence to the above hypothesis that Gemma3 considers repetition of a theory to be suggestive of its effectiveness. For *Molecules*, theory centrality (Figure 4) does not translate

to theory effectiveness (Figure 3), however, and it is not clear why. One possible reason is that theory can be called on in this field to harness simplifying assumptions (e.g., as in Density Functional Theory), reflecting research designs that are inherently less certain.

RQ3: Is theory use more effective when it is more explicit or more central to an article?

Across all fields, Gemma3 considers the named "main theory" to be more effective when it is more central or explicit in an article (Table 1). This does not imply that the more explicit or central theory use makes articles better, just that the contribution of whatever Gemma3 extracts as the "main theory" is more effective in these contexts according to one LLM. The weak positive correlations between the theory contributions of articles and the overall research quality of an article, as judged by Gemma3, does give evidence of this relationship, however (Table 2), albeit very weak evidence because of the main theory identification issues. This tends to mitigate against more subtle uses of theory in academic research.

RQ4: How is academic theory typically used in published journal articles, and what are the differences between fields?

Given the literature review, it is unsurprising that there are clear field differences in the role of the "main theory" in academic research, at least as judged by Gemma3 and ChatGPT (Figure 7). In this context, the dominance of theoretical perspectives in *Humanities* is expected (Popov and Chompalov, 2015) and the relatively large share for *Social Science* can be explained by the overlap between humanities and social sciences research, as well as the need for explicit discussions of theory in many areas of the social sciences (Popov and Chompalov, 2015). The almost total absence of theoretical perspectives from *Molecules* is also reasonable given that it is a biological science and studies objects that are conceived as real, simple and universal (e.g., Morgan and Morrison, 1999).

The confusion between theories and research fields or methods reflects Gemma3 errors, and perhaps also the lack of explicit theory contributions in the science-oriented journals *Molecules* and *Sustainability* (Figure 7). The almost complete absence of research paradigms, as identified by Gemma3 as the main theory, in all journals may also be an error in the sense that it may not strongly associate research paradigms with theories.

RQ5: Are individual-named theories more dominant in some fields than others?

Considering the "main theories" identified by Gemma3 that were characterised as "An academic theory" by ChatGPT, there are substantial differences between fields (journals) and the same is true if "A theoretical perspective" is included as well. Named academic theories are unsurprisingly least common for the science journal *Molecules*, although a minority of its articles include one.

The dominance of individual theories is highest in *Healthcare*, which may be a side-effect of the relatively narrow focus of the journal. The top Healthcare theories are implicit rather than explicit since they are rarely mentioned in the relevant article. In comparison, *Social Sciences* covers highly disparate fields, some of which may not use theories and others of which may have their own theories. In any case, the results suggest that no genuine theories are common in any field.

Conclusion

As apparently the largest scale analysis yet of academic theory use in journal articles, albeit with weak evidence, the results confirm previous suggestions that expectations of the nature of theory use in one field do not necessarily apply to other fields: whilst the results show this for a selection of broadly field-based MDPI journals, differences between purer field-based sets of articles would presumably have been larger. Thus, authors, reviewers, research methods lecturers, and evaluators should be cautious when evaluating the theoretical contributions of articles outside of their field. For example, in REF evaluations, senior academics may have to evaluate work from fields or specialities that they are not familiar with and should not draw negative conclusions from theory being used less than they would expect. The strength of the evidence undermined by the clear errors from Gemma3 in identifying "main theory" contributions in academic research. These problems may reflect the fact that the degree of explicitness of theory use in academic research varies substantially between fields, as the results suggest. Thus, the results of this study should be interpreted in the humanities sense as a perspective on theory use in academic research rather than strong evidence about it.

The results also (weakly, since based on limited evidence) suggest that when theory is invoked, in all fields it works best, or at least is most persuasive to Gemma3, when it is more explicit and central to the paper. They also suggest a high degree of heterogeneity of theories used, so authors and reviewers should not be restricted to the most popular theories. Moreover, theories for theoretical perspectives seem to be particularly important in the humanities. This is presumably known by most humanities scholars but should be recognised by others that engage with humanities work, either as co-authors or reviewers.

Finally, whilst this article seems to be the first empirical analysis of theory use in academic journal articles with a science-wide scope, its evidence is weak because it has not overcome the challenge of accurately identifying the theoretical contributions of journal articles. Identifying these theoretical contributions seems to be difficult for both humans and LLMs, and it seems likely that experts would frequently disagree due to fundamental disagreements about the nature of academic theory as well as how each individual study has used theory. If future research can make progress on either of these issues, then this might help to produce a better understanding of the nature of theory in academic research.

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