

## Exploring the Application of Large Language Models in Qualitative Research

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### Abstract

Large Language Models (LLMs) possess tremendous application potential in qualitative research, particularly within the two critical stages of data coding and interpretive construction. During the data coding process, LLMs can center on events or themes, exhibit advantages in preserving contextual information and maintaining the integrity of conceptual relationships, and accommodate both holistic and analytical requirements of event structures. In the interpretive construction process, LLMs can assist researchers in conducting holistic reviews, exploring underlying motivations, integrating sociocultural contexts, and achieving insightful interpretation and construction. The article presents an application framework and operational methods for LLMs in qualitative research through examples, providing researchers with a practical guide for rapid mastery. The article also proposes future research visions, including how to expand the application of LLMs across different research paradigms, as well as the applicability and effectiveness of LLMs' participation in qualitative research. Overall, LLMs demonstrate significant advantages in rapidly integrating large volumes of information and providing multi-perspective analyses, yet researchers themselves continue to play a critical role in the qualitative research process.

### Full Text

### Preamble

### Exploring the Application of Large Language Models in Qualitative Research

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## Abstract

Large Language Models (LLMs) demonstrate significant potential in qualitative research, particularly in the two critical processes of data coding and interpretive construction. In data coding, LLMs can focus on events or themes while preserving contextual information and the integrity of conceptual relationships, balancing both holistic and analytical demands of event structure analysis. During interpretive construction, LLMs can assist researchers in conducting comprehensive reviews, exploring underlying motivations, integrating socio-cultural contexts, and achieving insightful interpretation and theoretical construction. This article presents an application framework and operational methods for LLMs in qualitative research through concrete examples, providing researchers with a practical guide for rapid implementation. The article also proposes future research directions, including how to expand LLM applications across different research paradigms and examining the applicability and effectiveness of LLMs in qualitative research. Overall, while LLMs show notable advantages in rapidly integrating large amounts of information and offering multi-perspective analyses, researchers themselves continue to play a crucial role in the qualitative research process.

**Keywords:** Large Language Models (LLMs); qualitative research; data coding; interpretation construction; human-AI collaboration

Since the advent of computers in the mid-20th century, quantitative research has undergone revolutionary transformations. Computer technology has dramatically enhanced the efficiency of quantitative research, expanded its application scope and theoretical depth, and enabled its flourishing development worldwide. Today, applications of various statistical methods—from basic descriptive statistics to complex multivariate modeling—rely on computer technology. In recent years, artificial intelligence, particularly the rapid development of Large Language Models (LLMs), has similarly brought technological transformation opportunities to qualitative research. If computers can be considered capable assistants for quantitative research, then LLMs may become the “computers” for qualitative research. Currently, qualitative research is also facing opportunities and challenges brought by technological transformation.

As a complex and in-depth research methodology, qualitative research centers on systematically processing unstructured data to distill patterns, themes, and concepts, and further constructing explanatory pathways and theoretical frameworks (Creswell & Poth, 2016). As an important method in social sciences,

qualitative research carries significant research responsibilities but also faces numerous challenges. First, traditional manual coding is time-consuming and labor-intensive, with low efficiency, making it difficult to cope with the growing volume of unstructured data. Watkins (2017) noted that traditional qualitative analysis may take weeks to months to complete, posing a major challenge for time-sensitive research projects. Second, the transparency and replicability of qualitative research have long been focal concerns in academia. Aguinis and Solarino (2019) found that among qualitative studies published in top management journals, only a few meet standards of transparency and replicability. Additionally, the technical specifications of qualitative research are relatively complex. Saldaña (2021) emphasized that beginners struggle to master various coding techniques in qualitative research within a short time. Although Computer-Assisted Qualitative Data Analysis Software (CAQDAS) has improved research efficiency to some extent, Ahmad and Newman (2010) pointed out that these software tools still have limited capabilities in semantic understanding and knowledge extraction, failing to meet researchers' deeper needs. These factors collectively constitute bottlenecks restricting the promotion and development of qualitative analysis, making the traditional paradigm of "small-scale, manual, and fragmented" unsustainable (XXX, 2024).

In the context of the digital age, qualitative research can leverage AI technologies represented by LLMs to achieve methodological innovation. LLMs are deep learning-based natural language processing models that learn statistical patterns of language by training on massive text data. Their core technology is the Transformer architecture, which achieves global modeling of text through self-attention mechanisms, enabling them to generate high-quality, coherent text content. The breakthrough progress of LLMs in semantic understanding and generation is expected to bring breakthroughs in improving coding efficiency, expanding analysis breadth and depth, and supporting theoretical construction, thereby lowering the technical threshold of qualitative research. This can not only alleviate researchers' time and labor cost pressures and provide convenience for more researchers to enter the field of qualitative research, but may also fundamentally transform qualitative research paradigms. This transformation process is both a challenge and an opportunity. It requires researchers to maintain the core values of qualitative research while actively exploring the integration of new technologies with traditional methods, and rethinking the essence and boundaries of qualitative research. In recent years, breakthrough progress of LLMs in natural language processing has brought new technical possibilities for addressing these challenges. In terms of efficiency, LLMs can quickly process large amounts of unstructured data, significantly improving coding efficiency. Chew et al. (2023) demonstrated that LLMs can complete coding tasks in minutes that would take days using traditional methods, greatly shortening research cycles. Regarding transparency, unlike the "black box" thinking process of human researchers, LLMs can meticulously record and present their analytical processes. Wei et al. (2022) noted that LLMs can use chain-of-thought prompting to decompose complex reasoning tasks into step-by-step processes, providing

transparency in decision-making and making the process more interpretable and reproducible. In terms of replicability, the systematic processing of LLMs helps improve research replicability. Given the same data and instructions, LLMs can produce relatively consistent results, addressing the replicability issues in traditional qualitative research caused by differences in researchers' personal experiences and preferences (Zhao et al., 2023). However, we must also recognize that the deep learning-based computational process of LLMs still retains certain "black box" characteristics, and their probabilistic output also presents new challenges for research transparency and replicability (XX, 2024). Therefore, when using LLMs, we need to take measures to further "open the black box": meticulously document LLM parameter settings and input prompts to ensure research traceability; require LLMs to explain their reasoning processes so that human researchers can understand and evaluate their decision-making basis; and combine multiple runs to analyze the stability and consistency of LLM outputs.

## 1. Data Coding and Interpretive Construction in Qualitative Research

Different scholars have slightly different divisions of qualitative research stages. Creswell and Poth (2016) divide the qualitative research process into four main stages: research design, data collection, data analysis, and results presentation. Denzin and Lincoln (1995) more detailedly divide the process into stages including researcher positioning, theoretical paradigms, research strategies, data collection methods, analytical practices, and interpretation/evaluation, particularly emphasizing the importance of theory throughout the research process. Charmaz (2008), in grounded theory methodology, views data collection, coding, and theoretical construction as an intertwined, iterative cycle.

When using LLMs to assist qualitative analysis, we divide the process into two relatively independent stages: data coding and theoretical construction. This is because LLMs excel at processing and analyzing large amounts of unstructured data, but may still require deep human involvement and judgment in complex theory building and abstract conceptualization. Therefore, this article first 梳理s the core components of the analytical process in qualitative research, constructs an analytical step framework suitable for LLM assistance, and provides theoretical guidance for the structured application of LLMs.

Data coding is the foundational component of qualitative research, involving the structural processing of collected natural data. Miles et al. (2014) note that data coding is the core part of qualitative research; through information extraction, conceptual classification, and thematic categorization, researchers gradually distill meaningful patterns and themes from data, laying the foundation for research findings and theoretical construction. The thematic analysis framework technique proposed by Braun and Clarke (2022) further emphasizes the importance of coding and theme identification in qualitative research. Through systematic coding and thematic processing, researchers can identify and summarize core

themes in data, laying the groundwork for interpretation and theorization.

Interpretive construction is the ultimate goal of qualitative research. Based on data coding, researchers must interpret problems and provide theoretical explanations. Thornberg and Charmaz (2008) note that interpretation and theorization are the ultimate purposes of qualitative research. Through in-depth analysis of data, researchers can form new theoretical and explanatory frameworks that not only help understand specific phenomena but also provide foundations for more generalized theoretical construction. Creswell (2016) and others emphasize that interpretation and theorization are core tasks of qualitative research, through which researchers can elevate research findings to theoretical levels, thereby forming theoretical models of research.

It is worth noting that data coding and interpretive construction in qualitative research are not two completely separate stages. They influence each other and collectively constitute a complete qualitative analysis process. For example, grounded theory emphasizes the simultaneity of data coding and theory building; in ethnographic research, researchers also continuously deepen their understanding of research subjects during the process of collecting and analyzing data. As Miles (2014) stated, qualitative data coding is an interactive cycle involving data condensation, data display, and conclusion drawing/verification.

Table 1 梳理 s the requirements of existing major research techniques in data coding and interpretive construction. Overall, the main limitations of major qualitative research techniques lie in their strong dependence on researchers' personal knowledge backgrounds, research experience, and research habits, making the objectivity and replicability of research conclusions difficult to guarantee through research norms and institutions. Although various auxiliary coding software has been developed, their functions remain at the level of providing simple assistance for manual coding, failing to fundamentally solve the transparency and replicability issues of research processes. Therefore, developing a technology that can automatically assist qualitative research, helping inexperienced beginners quickly master and efficiently and objectively conduct qualitative research, will be of great significance for promoting the application of qualitative research methods and enhancing their scientificity and influence.

## Method: Data Coding

When employing LLMs to assist qualitative analysis, we divide the process into two relatively independent stages: data coding and theoretical construction. This is because LLMs excel at processing and analyzing large amounts of unstructured data, but may still require deep human involvement and judgment in complex theory building and abstract conceptualization. Therefore, this article first 梳理 s the core components of the analytical process in qualitative research, constructs an analytical step framework suitable for LLM assistance, and provides theoretical guidance for the structured application of LLMs.

## 2. Event- or Theme-Centered Data Coding

As shown in Table 1, data coding in qualitative research is a critical component, with different research methods having different requirements for the coding process. This section explores how to use LLMs for event- or theme-centered data coding, an approach that can accommodate the needs of various qualitative research methods listed in Table 1.

### 2.1 Advantages of Event/Theme as Core Coding Units

When implementing data structuring in qualitative research through LLMs, the primary task is to determine the basic meaningful units of structuring. Traditional qualitative research methods often start at the micro level, such as beginning with concept or category coding and gradually inducting until forming theory (Vanover et al., 2021). This is similar to constructing a complete picture by collecting tiny pixels. While this bottom-up approach ensures meticulous analysis, it faces limitations such as decontextualization, fragmented relationships, and time-consuming labor (Parker & Vannest, 2012). This makes it difficult for beginners to get started. Given the characteristics of LLMs and the needs of qualitative research, we propose a structuring strategy that uses relatively independent events or themes as the core units of structuring (XXX, 2024). Events or themes are defined as a series of closely related behaviors and emotional experiences exhibited by individuals. This approach not only balances micro and macro perspectives but also preserves rich contextual information as much as possible, maintains the integrity of inter-conceptual relationships, demonstrates better adaptability, and offers flexibility to “advance or retreat.”

**Holism and Contextual Information.** Traditional qualitative research requires researchers to read original materials line by line, which stems from limitations of human cognitive capacity. Some coding methods may separate originally closely related concepts, destroying inter-conceptual relationships (Elliott, 2018; Richardson, 1987). For beginners, this process often leads to losing grasp of contextual information and holistic conceptual relationships. LLMs can process the overall context and local details of text holistically, simultaneously capturing multi-dimensional contextual information such as time, place, participants, and behavioral processes, providing rich background and deeper understanding for research (Gurnee & Tegmark, 2023). For example, when studying urban residents’ experiences using shared bicycles, traditional coding might yield a series of independent concepts such as “convenience” and “parking difficulties,” requiring researchers to later work hard to integrate these independent concepts into an explanatory theoretical framework. In contrast, the event-centered approach can identify complete events at once: “During Monday morning rush hour, Mr. Zhang rode a shared bicycle to the subway station, encountered traffic congestion along the way, arrived smoothly but then struggled to find a suitable parking spot.” This event unit not only encompasses multiple concepts but also preserves the spatiotemporal connections and specific contexts of personal experience, providing more comprehensive and interpretable dynamic

characteristics for understanding shared bicycle usage experiences. The event- or theme-centered analysis method can capture the dynamic characteristics and change processes of research subjects, particularly suitable for time-series or process-oriented research. This method preserves the complexity and integrity of phenomena, laying a solid foundation for subsequent theoretical construction. The powerful pattern recognition and relational reasoning capabilities of LLMs help discover potential patterns and valuable theoretical constructs within these complex event or theme units (Mirchandani et al., 2023). For example, when examining the dynamic characteristics of adolescents' internet usage behavior, traditional methods might separate static concepts such as "internet addiction" and "social anxiety." In contrast, the event-centered approach can identify continuous causal chains of events: "Xiao Wang used social media in the evening, initially to interact with friends, but gradually felt loneliness and anxiety, eventually playing until late at night, feeling extreme exhaustion and guilt." This causal chain of events demonstrates the dynamic change process from behavior to emotional experience of the individual, providing more holistic insights for deeply understanding adolescents' internet usage behavior and offering operational technical groundwork for subsequent theoretical construction.

**Flexibility to "Advance or Retreat."** "Advance" is reflected in the ability to further abstract, interpret, and theorize based on events/themes as units, achieving comprehensive and in-depth interpretation of materials. First, by comparing multiple events/themes, researchers can identify recurring patterns and themes, distill concepts at higher levels of abstraction (Charmaz, 2008), and finally construct explanatory theoretical frameworks (Corbin & Strauss, 2015). For example, when studying the psychological process of adolescent internet addiction, researchers might first identify multiple related events such as "first contact with online games," "alienation from real-world friends," "declining academic performance," and "increasing family conflicts." Through analysis and comparison of these events, researchers might discover recurring patterns such as escaping real-world pressure, achievement in virtual worlds, and shifting social needs. Researchers might form a higher-level concept such as "virtual identity formation" to explain why adolescents continuously invest large amounts of time in online activities. Researchers might construct a holistic theoretical framework explaining how factors such as real-world pressure, virtual world attraction, personal characteristics, and social support systems interact to ultimately cause and maintain adolescent internet addiction behavior. "Retreat" refers to the ability to further decompose based on a single event/theme. This approach not only helps "open the black box" of large language models, facilitating researchers' assessment of output accuracy, but also helps researchers deeply understand the various elements of a single event/theme itself. In addition to the elements proposed in this article—spatiotemporal background, participants, motivations and goals, behavioral processes, emotions and cognition, results and impacts—researchers can "customize" elements of events/themes according to their own methods or schools. For example, researchers based on grounded theory could try elements such as "event label," "event definition," "event at-

tributes,” “preconditions,” “coping strategies,” and “event outcomes” (XXX, 2024). Furthermore, the “retreat” characteristic is particularly important when using large language models for qualitative research. Through detailed decomposition of individual events, researchers can better assess the accuracy and reliability of model outputs. For example, researchers can compare the “first addiction” time identified by the model with manually coded results, checking whether the model accurately captures various elements of events, especially those subtle emotional and cognitive changes that require rich psychological knowledge to identify.

“Advance” and “retreat” are not two independent processes but rather mutually supportive and reinforcing. Through in-depth analysis of a single internet addiction event (retreat), researchers can obtain rich materials and insights, providing a solid foundation for subsequent conceptual abstraction and theoretical construction (advance). Conversely, in the process of constructing a theoretical model of internet addiction, researchers may need to return to specific events repeatedly to verify or revise their ideas, which again demonstrates the value of “retreat.” This bidirectionality makes the event/theme-centered coding method particularly suitable for exploratory psychological research and theory construction. It allows researchers to continuously travel back and forth between data and theory, gradually refining and developing theoretical perspectives. This approach echoes the core concept of grounded theory, emphasizing that theory should emerge from data rather than being imposed on data (Wasserman et al., 2009). Simultaneously, it provides researchers with a structured method to manage and analyze complex qualitative data, thereby improving the reliability and credibility of psychological research.

Therefore, this event- or theme-centered coding method not only meets the needs of various qualitative research methods listed in Table 1 but also provides a better structural foundation for LLM applications.

### 2.3.1 Text Data Preparation

Although LLMs demonstrate powerful capabilities in processing diverse text inputs, data preparation remains an indispensable and critical step. First, before data processing, researchers must carefully remove personal identifying information or anonymize it. This is not only to ensure full protection of research participants’ privacy rights but also to meet data protection regulations. Regulations such as the EU’s General Data Protection Regulation (GDPR) and the US’s California Consumer Privacy Act (CCPA) have established strict privacy protection requirements (Voigt & Von dem Bussche, 2017). The choice of anonymization techniques should be determined based on data sensitivity and research needs, potentially including data masking, pseudonymization, or more complex differential privacy techniques (Marques & Bernardino, 2020). Second, although LLMs can process various data formats, maintaining consistent formats can significantly improve analysis reliability and replicability. Uniform data formats help reduce errors caused by format differences, making research

results more stable and credible. Additionally, preliminary data cleaning is crucial for improving analysis quality. This includes proofreading obvious transcription errors and handling incomplete sections, but care must be taken not to “clean” data excessively and lose meaningful expressions or details that may be significant in qualitative research. For multilingual data or texts containing dialects or special expressions, careful handling is required, possibly needing annotation explanations. According to research needs, preliminary structural annotations may also be necessary, such as adding time markers, scene descriptions, or theme labels.

The data example used in this article comes from an interview collected by a member of our research team, see the appendix.

### 2.3.2 LLM Parameter Confirmation

In LLMs, “temperature” typically refers to a parameter setting used when generating text to control the randomness and creativity of the generated text. This concept borrows from the “temperature” concept in physics, used as a metaphor for the “heat” or diversity of text generation by the model. Temperature settings usually range from 0 to 1. When the temperature value is set low (close to 0), the model’s output becomes more deterministic and repetitive, tending to select words with the highest probability, thereby generating more fluent and reasonable text but potentially sacrificing some creativity and diversity. When the temperature value is set high (close to 1), the model’s output becomes more random, increasing the diversity and creativity of generated text.

We generally prefer using low temperature settings, such as 0.1. This setting produces more deterministic and consistent outputs, suitable for scientific research needs. In addition to temperature settings, other parameters need consideration, such as maximum tokens, stop sequences, frequency penalty, and presence penalty. Notably, these advanced parameters can typically only be set during API calls and cannot be directly adjusted on most LLM official web interfaces. Figure 1 [Figure 1: see original paper] shows the temperature setting interface of Chatbox (version 1.4.1), an API-callable tool.

### Figure 1. Chatbox Client Version Setting Interface

### 2.3.3 Extracting Overall Event or Theme Lists

The specific implementation process involves: first, having LLMs identify key events or themes in the text (the original interview text is provided in the appendix); second, having LLMs conduct in-depth analysis of the elements contained in each event or theme.

For the first step, the following prompt can be used as reference:

**Task:** Identify and extract key events or themes from the given text material and present them in table format.

**Requirements:** 1. Conduct an overall reading and understanding of the entire text. 2. Identify the main events or themes in the text. Each event or theme should be a relatively independent, meaningful unit. (Similar or closely related events may involve content from different locations and should be treated as a single event without repeated presentation.) 3. Summarize a title for each event or theme and provide three dimensions: “Importance Level (1-9 points),” “Event/Theme Description,” and “Extraction Reason,” sorted by importance level from high to low.

**Notes:** - Maintain overall understanding of the text; do not ignore contextual information. - Ensure each event or theme has sufficient independence and completeness. - Pay attention to capturing dynamic processes and changes. - List all events as comprehensively as possible to prevent omissions.

**Research Field Note:** This is a psychology-related interview, so I hope to focus more on “psychological experiences.”

The results of the first step event/theme identification are presented in Table 2 :

**Table 2. Extracted Events/Themes**

No.	Event/Theme	Description	Extraction Reason
1	Complex Relationship with Mother	The subject has complex emotional attachment and conflict with her mother. On one hand, she is very dependent on her mother and desires to maintain contact; on the other hand, her mother’s frequent criticism and focus on her weight lead to frequent arguments and emotional fluctuations.	This theme runs throughout the entire interview, affecting the subject’s emotions, decisions, and self-perception. It reflects the subject’s core psychological conflicts and growth challenges.

No.	Event/Theme	Description	Extraction Reason
2	Academic and Career Pressure	The subject faces decision pressure about whether to continue her education, while worrying about failing to meet her mother's expectations. This pressure stems from uncertainty about her own abilities and concerns about her mother's possible reactions.	This theme reflects the main life challenges the subject currently faces, affecting her emotional state and future development direction.
3	Sports Training Conflict	The subject faced conflict between sports training and academics in high school, ultimately choosing to abandon the path of being a sports specialty student, but this decision triggered disputes with her mother.	This event demonstrates the subject's decision-making ability and autonomy, while also highlighting difficulties in communicating with her mother.
4	Emotional Control Issues	The subject describes herself as easily irritable, especially when interacting with her mother and sister, finding it difficult to control her emotions and frequently arguing.	This theme reflects the subject's mental health status and interpersonal patterns, possibly requiring further psychological support.

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No.	Event/Theme	Description	Extraction Reason
5	Security Seeking	The subject shows strong attachment to her mother and sister, believing that she can only obtain security when with them.	This theme reveals the subject's attachment patterns and psychological needs, which are important for understanding her behavioral motivations.
6	Comparison with Sister	The subject repeatedly mentions differences between herself and her sister in personality and relationship with their mother.	This theme reflects family dynamics and the subject's self-perception, but is not the core focus of the interview.
7	Family Financial Pressure	The subject repeatedly mentions family financial pressure, which affects her educational choices and self-worth.	This theme reflects the subject's family background and values, which are somewhat helpful for understanding her decisions and emotions.
8	Blood Donation Experience	The subject was late due to blood donation, showing anxiety about time management and emphasis on punctuality.	Although this event is not the main content of the interview, it reflects the subject's personality traits and values.

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#### 2.3.4 In-Depth Analysis of Each Event/Theme

The first step extracts independent events or themes. The second step then conducts in-depth and detailed analysis of each event or theme, presenting researchers with a “magnified” view. The focus of the second step is original text extraction and element parsing. The main reason for separating these two parts is to output sufficient content. Since most large models have output limits, the original text extraction content being too long would lead to incomplete output. Segmented output can maximize the adequacy and accuracy of results. The original text extraction prompt is as follows:

**Next, for Event/Theme 1, first conduct original text extraction (Quotation):** Extract original content that can reflect the event, mark it with serial numbers according to the order of appearance, as the basis and illustration for coding, as comprehensively and accurately as possible. If a paragraph is long (exceeding 60 characters), present the excerpt and use “...” for abbreviation.

The output effect is as follows. **Claude 3.5:** Okay, I will conduct original text extraction for Event/Theme 1 “Complex Relationship with Mother.” I will number them according to the order of appearance in the text and extract relevant content as comprehensively and accurately as possible. For longer paragraphs, I will present key excerpts and use “...” to indicate omitted parts.

1. “My personality is somewhat different from hers.”
2. “I can feel it. Our family is actually quite balanced, because she wasn’t with me when she was young, that is, before elementary school, when we were small, my grandmother was there, because she was too busy, I was with my mother, she was with my grandmother...”
3. “Right, honestly, my relationship with my mother is quite good, much better than my sister’s, because my sister is moderate, she can only be said to be in a moderate position in the whole family, but I personally am very biased toward my mother.”
4. “I would definitely give it a 10.” (Response to rating attachment to mother)
5. “It’s not even communication, arguing is simply about who has the louder voice, it’s about who has more momentum, when arguing my mother has no reason, she can’t hear what I’m saying at all, she thinks everything I say is wrong, so I don’t have a chance to communicate, well, she somewhat doesn’t listen.”
6. “Her support doesn’t really matter, because she has this magical thing, hindsight, she scolds well, suddenly after scolding, I can’t be bothered with her, I don’t want to argue with her anymore...”
7. “What did I gain? I gained... I think there’s this sense of security.”
8. “Right, it’s not to the point of me getting angry, but I don’t know why I just get angry.”
9. “But my mother’s idea is, I think my mother’s wishes for the future are quite beautiful, for example, me, actually honestly, my mother’s pressure only comes from my uncle, my uncle graduated from Xi’an Jiaotong University, because his education is quite high, he’s a PhD, then he went to work for a foreign company, his monthly salary was how many US dollars I forgot, it’s a large amount...”
10. “She only sees what she thinks is bad about me, she never says good things about me, never, but good things? She never says.”
11. “Right, so actually I think my relationship with my mother only has problems with the way we get along, other aspects should be fine, because my mother is quite partial to me, if I want something she generally gives it to me.”
12. “I would tell her like this, but after telling her she would say no, what I said wasn’t wrong either, look how fat you are and so on, she would

- continue, because it doesn't change anything.”
13. “Right, forced separation, because if I continue talking she will keep talking, there's no difference, I might as well directly tell her I don't want to listen.”

These excerpts cover multiple aspects of the subject's relationship with her mother, including attachment, conflict, communication difficulties, emotional needs, etc., reflecting the complexity and importance of this relationship.

**Element Parsing Prompt:**

Please extract based on the content related to Event/Theme 1 in the original document. For each main element (spatiotemporal background, participants (people involved in the event, not the interviewer), motivations and goals, behavioral process, emotions and cognition, results and impacts) and its sub-elements, provide specific descriptions. The analysis should be based on actual information in the text, avoiding speculation. If certain information is not explicitly mentioned in the text, please note “insufficient information.” Finally, organize the analysis results into a clear table, making descriptions of each element and sub-element 一目了然.

The output results are shown in Table 3 . This process will be iterative, depending on how many events or themes are extracted. For example, if eight events or themes are extracted, the “magnification” will be performed eight times.

**Table 3. Element Analysis of Event/Theme 1 “Complex Relationship with Mother”**

Element	Sub-element	Description
<b>Spatiotemporal Background</b>	Time	From before the subject's elementary school to present, focusing on middle school, high school, and university stages
	Location	Mainly at home and through phone calls
	Context	Twin family, busy working parents, significant financial pressure
<b>Main Participants</b>	Subject and her mother	
<b>Secondary Participants</b>	Subject's sister (twin), father, grandmother	
<b>Participant Characteristics</b>	Subject: emotional, attached to mother; Mother: busy, high expectations for children, poor emotional control	

Element	Sub-element	Description
<b>Motivations and Goals</b>	Subject's explicit goals	Seeking mother's understanding and recognition
	Subject's implicit motivations	Seeking security
	Mother's explicit goals	Hoping children excel (good academics, proper weight)
	Mother's implicit motivations	Realizing her own expectations through children
<b>Behavioral Process</b>	Event sequences	1. Childhood: Subject primarily raised by mother, sister by grandmother, creating different attachment patterns 2. Middle school: Frequent conflicts with mother over academics and weight 3. High school: Conflict between sports training and academics, mother opposed giving up sports specialty 4. University stage: Frequent phone calls but continued conflicts
	Conflict and coordination	Conflicts: Views on subject's weight and academics; Coordination: Subject tries to meet mother's expectations
	Cyclical patterns	Mother criticizes → Subject retorts → Argument → Subject seeks reconciliation
	Decision-making	Subject considers mother's opinions in major decisions (e.g., academic choices) but maintains some autonomy
<b>Emotions and Cognition</b>	Subject's emotional reactions	Attachment, irritability, anger, guilt

Element	Sub-element	Description
<b>Results and Impacts</b>	Subject's cognitive patterns	Thinks mother overly focuses on appearance and academics; believes mother has "incorrect values" but still values mother's opinions
	Mother's emotional reactions	Anxiety, dissatisfaction
	Mother's cognitive patterns	Thinks subject doesn't try hard enough
	Direct results	Frequent arguments, tense but still intimate relationship
	Impacts on subject	Subject's self-evaluation and decision-making affected by mother; poor emotional control
	Unexpected outcomes	Subject's high attachment to mother (rating of 10) despite complex relationship

### 2.3.5 Manual Review

Researchers need to carefully review the above event/theme extraction and its various elements. This step is crucial as it ensures the accuracy and completeness of subsequent analysis. Researchers should check whether the description of each event accurately reflects the original data and whether various elements (such as spatiotemporal background, participants, motivations and goals, etc.) are correctly identified and described. If any inaccuracies or incompleteness are found, researchers should make corrections. This process may require multiple rounds of checking and revision until researchers are confident that these structured data truly reflect the original materials.

## 3. Interpretive Construction Using LLMs

After completing data coding, the next critical step in qualitative research is interpretation and construction. Qualitative research requires researchers to interpret phenomena, gain insights into essences, reveal patterns, and construct understanding (Kemperaj & Chavan, 2013). As shown in Table 1, different research methods have different focuses at this stage, from theory generation in grounded theory to revelation of essential structures in phenomenological research.

With the rapid development of Large Language Model (LLM) technology, a thought-provoking question emerges: Can machines also complete this complex cognitive task like humans? Based on the data structuring methods discussed earlier, LLMs can extract numerous independent “event pictures” for us. However, the real challenge lies in how to connect these static pictures, “understand” them deeply, and reveal the developmental patterns and internal mechanisms within them. The advantages of LLMs seem obvious: they can conduct large-scale knowledge integration, quickly access relevant interdisciplinary information, and provide a relatively objective perspective not directly influenced by personal experience and emotion, which may help reduce researcher bias (XX, 2024). Moreover, LLMs can quickly generate and preliminarily validate multiple explanatory hypotheses, seemingly greatly accelerating the theory construction process.

### 3.1 Exploring Approaches to LLM-Assisted Interpretive Construction

The various qualitative research methods listed in Table 1 have different emphases in the interpretive construction stage. For example, grounded theory emphasizes theory generation, while phenomenological research focuses on revealing essential structures. To cover these different needs, we propose a four-step interpretive construction framework: holistic review, deep motivation exploration, socio-cultural context integration, and insightful interpretation and construction (see Table 4). The selection of these four perspectives is based on a deep understanding of the complexity of human behavior and experience, as well as the development of qualitative research methodology.

**Holistic Review** is the cornerstone of the deep interpretation and construction process, requiring researchers to conduct comprehensive examination of all collected events, including event content, temporal sequence, and potential causal relationships (Tucker, 2004). At this stage, researchers capture the developmental trajectory and underlying logic of individual life courses through overall 梳理 ing of events (Charmaz, 2008). This comprehensive review focuses not only on details of each event but also emphasizes connections between events, thereby providing a foundation for further interpretive construction (Miles et al., 2014). In this process, LLMs demonstrate their exceptional data processing and integration capabilities, able to quickly analyze large amounts of event data, identify temporal sequences and potential causal relationships, providing researchers with comprehensive and concise reviews that highlight key turning points (Snell et al., 2024). This capability is particularly useful when processing large-scale qualitative data, laying a solid foundation for subsequent in-depth analysis.

**Exploring individuals’ deep motivations and psychological mechanisms** is key to understanding human behavior. This stage may involve considering individuals’ early experiences, important interpersonal relationships, socio-cultural backgrounds, and other factors to understand the roots of their behaviors and emotional reactions. Psychodynamic concepts such as defense

mechanisms, internal conflicts, or attachment patterns play important roles at this stage (Perrotta, 2020; Weinberger, 1998). Additionally, narrative psychology (McAdams, 1996) and meaning-making theory (Bruner, 1990) propose different understandings from their respective perspectives. These theories emphasize that individuals create meaning and identity by constructing and telling their own life stories. Deep motivations are not just hidden psychological forces but core themes and values in individual life narratives. With vast knowledge reserves and “understanding” capabilities, LLMs seem able to propose reasonable hypotheses about individuals’ deep motivations based on these theories (though not necessarily correct), considering individuals’ experiences from multiple perspectives and providing in-depth and comprehensive analysis.

The importance of **socio-cultural context integration** stems from social constructivism (Berger & Luckmann, 1966) and ecological systems theory (Bronfenbrenner, 1979). These theories emphasize that individuals’ behaviors and experiences are always embedded in specific socio-cultural environments. By placing individual experiences in broader socio-cultural contexts, researchers can understand how social structures, cultural norms, and historical events shape individuals’ experiences and self-perception. LLMs may excel in this area because they have extensive knowledge bases that can connect personal experiences with macro factors such as social, cultural, and historical contexts (Pock et al., 2023).

**Insightful interpretation and construction** is the ultimate goal of the deep interpretation process. The importance of this stage is reflected in methods such as grounded theory (Heath & Cowley, 2004) and interpretative phenomenological analysis (Smith & Osborn, 2008). These methods emphasize that the goal of qualitative research is not only to describe phenomena but to construct theoretical models that explain these phenomena. By integrating analyses from the first three perspectives, researchers can construct a comprehensive explanatory framework that clarifies the internal logic and meaning of individual experiences. At this stage, LLMs can assist researchers in integrating multiple theoretical perspectives and proposing innovative explanatory models. For example, the thematic analysis method proposed by Braun and Clarke (2022) emphasizes identifying patterns and themes in data; LLMs facilitate this by helping researchers identify these patterns in large amounts of data, thereby facilitating theoretical construction.

Deep interpretation and theoretical construction is a dynamic, iterative process. As our understanding of data deepens, the interpretive framework requires continuous revision and improvement. This process aims to construct an explanatory model that both faithfully reflects individuals’ unique experiences and reveals universal human insights. Additionally, researchers need to fully recognize the close relationship between LLM output quality and input precision and specificity. This requires researchers to have a deep understanding of LLM working principles and the ability to design effective prompts to ensure analysis directions align with research goals. Simultaneously, researchers should remain vigilant, striving to identify and reduce potential biases in LLMs that

may originate from training data. As a core characteristic of qualitative research, researcher reflexivity becomes particularly important when using LLMs. Researchers need to maintain critical thinking throughout, deeply considering limitations and biases that LLM analysis may introduce, and maintain their own reflexivity throughout the research process.

**Table 4. Process (Perspectives) and Prompts for In-Depth Individual Interpretation and Construction**

Perspective	Goal	Prompt
<b>Holistic Review</b>	Gain overall sense of individual experience	Please comprehensively review all extracted events/themes and summarize the overall context of this individual's experience. Focus on temporal sequence and potential causal relationships between events/themes. Provide a concise overview highlighting key turning points.
<b>Deep Motivation Exploration</b>	Explore individual's deep motivations and psychological mechanisms	Deeply analyze the individual's behaviors and emotional reactions, speculating on possible deep motivations and psychological mechanisms. Propose several hypotheses about deep motivations and explain your reasoning.

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Perspective	Goal	Prompt
<b>Socio-Cultural Context Integration</b>	Understand individual experience within broader socio-cultural context	Analyze how the individual's experience is shaped by broader socio-cultural factors. Consider influences of cultural norms, social expectations, and historical background. If applicable, provide specific examples showing how these macro factors affected the individual's choices and behaviors.
<b>Insightful Interpretation and Construction</b>	Construct overall explanatory framework or theoretical model	Based on previous analyses, construct an overall explanatory framework or theoretical model to explain this individual's main experiences, behavioral patterns, and psychological characteristics. Then propose possible theoretical revisions or extensions to more profoundly explain observed phenomena.

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### 3.2 Example of Using LLM for Interpretive Construction

Based on the aforementioned data processing and after manual review and confirmation, we further requested LLMs to construct interpretive models. The pre-analysis prompt: "Next, in qualitative research, theoretical construction is needed for the extracted events/themes. The steps or perspectives are as follows: ..." Note that before this prompt, the previously extracted event/theme

list must be included. Then, by using the prompts in Table 4, we guided LLMs to systematically complete the process of in-depth individual interpretation and model construction.

Researchers can also appropriately select, adjust, or supplement these prompts according to specific research needs and theoretical orientations. Based on the prompts in Table 4, the output results are as follows:

### 1. Holistic Review: Gaining Overall Sense of Individual Experience

This individual's experience can be summarized as emotional fluctuations and psychological struggles when facing multiple pressures during the transition from adolescence to adulthood. The subject's life revolves around several main themes: emotional management difficulties, conflict and attachment in mother-daughter relationships, uncertainty and anxiety about the future, impact of family financial conditions, and self-identity and social comparison.

From a temporal perspective, emotional management problems emerged early and gradually intensified as the individual matured. Conflicts and attachment in mother-daughter relationships run through the entire growth process, particularly evident in academic pressure and weight issues. As academic pressure increased, especially during university, the subject's uncertainty and anxiety about the future gradually emerged, and conflicts with her mother further intensified. Family financial conditions directly affected her educational choices, causing her to compromise when pursuing personal ideals. Self-identity issues have existed from childhood to adulthood, influenced by multiple factors including family, school, and society.

Key turning points include: - **Middle school period:** Emotional management problems began to significantly affect her life, particularly manifested in interactions with her mother. - **High school to university transition:** Academic pressure and anxiety about the future intensified, mother-daughter conflicts escalated. - **University stage:** Facing pressure from the college entrance examination for associate degree holders, family financial conditions and self-identity issues became particularly prominent, affecting her decision-making and psychological state.

### 2. Deep Motivation Exploration: Exploring Individual's Deep Motivations and Psychological Mechanisms

The subject's behaviors and emotional reactions may be driven by the following deep motivations and psychological mechanisms: - **Seeking mother's recognition and love:** Despite frequent conflicts with her mother, the subject has strong attachment to her. This attachment may stem from her desire for maternal love and need for recognition. Her mother's high expectations regarding her body and academics make her particularly sensitive in these areas, leading to anxiety and self-doubt. - **Self-worth confirmation and anxiety:** When facing social comparison, especially with successful relatives (like her uncle), the subject feels her self-worth is threatened. This comparison may strengthen

her dissatisfaction with her abilities and appearance, further intensifying her emotional fluctuations and anxiety. - **Family responsibility and guilt:** The subject's sensitivity to family financial conditions reflects her sense of responsibility and guilt. She realizes her parents have sacrificed a lot for her and her sister, so she compromised in her educational choices. This sense of responsibility may be an important motivation for her efforts to study and try to meet her mother's expectations. - **Powerlessness in emotional management:** The subject seems to feel powerless about her emotional fluctuations, especially when interacting with family members. Her irritability and agitation may be reactions to daily pressures and internal anxiety, but she has difficulty controlling these emotions, leading to feelings of guilt and self-blame afterward.

### 3. Socio-Cultural Context Integration: Understanding Individual Experience Within Broader Socio-Cultural Context

The subject's experience is deeply influenced by Chinese socio-cultural background, particularly in family structure, educational pressure, and social comparison: - **Family structure and parent-child relationships:** In traditional Chinese culture, parents' expectations for children and children's responsibilities to parents occupy important positions. The subject's mother's high expectations for her academics and weight may reflect the "hoping one's child will become a dragon/phoenix" mentality in family culture. In this cultural context, conflicts and attachment in mother-daughter relationships become particularly prominent. - **Educational pressure:** Chinese society's high emphasis on academic achievement, especially performance in major exams like the college entrance examination and associate degree entrance exam, creates enormous pressure on the subject. Her anxiety and uncertainty may be reactions to this social pressure. - **Social comparison and self-identity:** In China, social comparison is often conducted through successful people within and outside the family. The subject's comparison with her uncle's success and her mother's high evaluation of it may increase her dissatisfaction and anxiety about herself. This social comparison not only affects her self-identity but also intensifies her emotional fluctuations.

### 4. Insightful Interpretation and Construction: Building Overall Explanatory Framework or Theoretical Model

Based on the above analysis, an overall explanatory framework can be constructed to understand the subject's main experiences, behavioral patterns, and psychological characteristics: - **Emotional Management Dilemma and Socio-Cultural Pressure Model:** This model can be summarized as the subject facing multiple socio-cultural pressures (such as family expectations, educational pressure, social comparison) with insufficient emotional management capacity, leading to difficulties in handling interpersonal relationships and self-identity issues. This dilemma reflects individuals' psychological struggles under traditional family structures and modern social pressures. - **Attachment and Conflict Dual-Dynamic Mechanism:** This mechanism explains the complex relationship between the subject and her mother. Attachment and conflict co-

exist simultaneously, driving her to show contradictory attitudes in behavior and emotion. This mechanism indicates that while individuals seek emotional support, they also generate negative emotions due to unmet expectations. - **Responsibility and Self-Worth Trade-off Theory:** This theory emphasizes the subject's trade-off between family responsibility and self-worth. She tries to achieve self-worth by meeting family expectations, but when facing difficulties, internal anxiety and powerlessness weaken her self-confidence.

Through these models, we can more profoundly understand the subject's experiences and provide theoretical references for similar cases. Additionally, these models can be further expanded to cover emotional management issues and attachment-conflict phenomena in parent-child relationships under different socio-cultural backgrounds.

To more clearly present relationships between variables, researchers can use LLMs to generate visual charts. For example, researchers can provide LLMs with the data coding materials obtained in the first step and request them to 梳理 relationships between variables and generate Mermaid code to construct charts, as shown in Figure 2 [Figure 2: see original paper].

**Reference Prompt:** Please 梳理 the relationships between various variables based on the uploaded document, provide reasons, and output Mermaid code.

However, charts generated by LLMs are not always satisfactory. Researchers can guide LLMs to generate charts more aligned with expected results by modifying prompts, such as explicitly specifying chart types, hierarchical relationships, or emphasizing specific relationships. In Figure 2, LLMs identified the core problem and interpreted it from three domains: family factors, socio-cultural factors, and individual coping strategies, further detailing specific content in each domain.

#### **Figure 2. Relationship Diagram of Event/Theme Relationships 梳理 ed Using LLMs**

*Note: Image drawn by Mermaid.*

## **4. Summary**

LLMs have demonstrated tremendous potential in qualitative research, particularly in data coding and interpretive construction. The event- or theme-centered data coding method provides a feasible framework for LLM applications. This method preserves rich contextual information while maintaining the integrity of inter-conceptual relationships, showing strong adaptability—consistent with Braun and Clarke's (2022) view on maintaining data holism and contextuality. However, oversimplifying complex phenomena is a potential risk of this method, and Saldaña's (2021) emphasis on meticulous coding methods remains indispensable in some situations. When using LLMs for coding, a balance must be struck between holism and meticulousness.

LLMs' ability to quickly integrate information and conduct multi-perspective analysis compensates for human researchers' cognitive limitations. Shen et al.'s (2023) research also confirmed LLMs' unique advantages in processing complex social phenomena. The four-step interpretive construction framework—holistic review, deep motivation exploration, socio-cultural context integration, and insightful interpretation and construction—provides structured methodological guidance for LLM applications. This framework balances individual experiences and macro socio-cultural contexts, echoing Bronfenbrenner's (1979) ecological systems theory; Sun et al.'s (2023) research also further supports the importance of this multi-level analysis. However, this framework also faces limitations in applicability when dealing with some phenomenological research (Borsboom et al., 2021).

In future research, exploring LLM applications across different qualitative research paradigms will be an important direction. Each research paradigm has its unique theoretical foundations and methodological requirements, and LLM applications need corresponding adjustment and optimization. For example, in phenomenological research, LLMs may need to be trained to identify and describe individuals' lived experiences, capturing their essential structures rather than just surface themes or patterns. In grounded theory research, LLMs can be used to assist open coding and axial coding processes, but researchers need to ensure LLMs do not overly influence theory generation, maintaining the "grounded" nature of theory. For ethnographic research, LLMs may play a role in processing large amounts of field notes and observational data, but researchers need to carefully consider how to maintain cultural sensitivity and deep understanding. In narrative research, LLMs can assist in identifying story structures and themes, but interpreting the uniqueness and meaning of personal experiences still requires deep researcher involvement.

Some researchers have raised philosophical-level criticisms about AI's subjectivity issues in qualitative research. They argue that AI technology intervention may shake human subjectivity in research. This article hopes to point out that such criticisms risk categorical errors: they ignore the differences between actual research and philosophical speculation. Within the scope of operational research, we should distinguish the concepts of "understanding" and "dialogue" used in daily life from those in philosophical discussions. In research contexts, "understanding" focuses more on accurate identification, classification, and interpretation of data patterns and meanings, while "dialogue" can be viewed as information exchange and interaction processes. LLMs' ability to quickly process and integrate information can be considered a "compressed" dialogue process. LLMs' ability to holistically understand text and extract it by event may be more comprehensive and objective than human line-by-line reading. In research, "understanding" does not equal completely replicating human psychological processes or emotional experiences. If AI can accurately identify themes, emotional tendencies, and potential meanings in text, and connect them with more generalized theoretical frameworks, we can consider that AI has achieved the "understanding" level required for research. In recent years, the outstanding

performance of advanced LLMs on these tasks has led more and more people to accept this view.

However, we must recognize the limitations of LLM applications in qualitative research. First, prerequisites for using LLMs include researchers having sufficient understanding of LLM working principles and the ability to design effective prompts. This requires specialized training and practice from researchers, potentially increasing initial research costs. Second, LLMs may have “hallucination” problems, generating content that seems plausible but is actually inaccurate. In complex qualitative data analysis, LLM hallucination problems may lead to incorrect coding or interpretation. Additionally, LLMs may have biases (though much less than humans), which originate from their training data and may inadvertently influence research results. Therefore, researchers currently cannot fully rely on LLMs but should treat them as auxiliary tools, always maintaining critical thinking and human supervision.

In summary, AI represented by LLMs already has the capability to participate in qualitative research and may bring new dimensions and depth to it. However, researchers’ professional judgment, critical thinking, and reflexivity are also indispensable in the process of using LLMs. LLM applications in qualitative research still require more exploration, including their applications across different research paradigms, how to better combine them with traditional methods, and in-depth research on ethics, reliability and validity assurance, and researcher capacity building. With technological development and research deepening, we believe LLMs will play an increasingly important role in future qualitative research.

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