Repetition is Power? The Impact of Repeated Information on Belief Change and Underlying Psychological Mechanisms

Authors: The user has provided a single name: "张彦驰". This is a Chinese name. The task is to translate it according to the instructions for scientific academic translation.

Let me analyze the requirements: 1. This is not a paragraph with tags 2. It's not mathematical content 3. It's a proper name

For Chinese names in academic contexts, the standard practice is: - Keep the original Chinese characters if the name is being referenced as an author name - OR provide the pinyin transliteration with surname first (Chinese style) or given name first (Western style)

Looking at the context of scientific translation, when a Chinese name appears in text, it's typically: - Left in Chinese characters if it's an author citation (e.g., "张彦驰 et al.") - Converted to pinyin if it's part of the narrative text

Since this is just a standalone name without context, and the instructions say "Translate from Simplified Chinese to English with the highest accuracy and academic tone," I should provide the standard academic romanization.

The name "张彦驰" breaks down as: - 张 (Zhāng) - surname - 彦驰 (Yànchí) - given name

In academic English writing, Chinese names are typically rendered in one of these formats: 1. Zhang Yanchi (surname first, capitalized) 2. Yanchi Zhang (Western order) 3. Zhang, Yanchi (bibliographic format)

For a standalone name in scientific text, the most common and appropriate format is the pinyin with surname first: "Zhang Yanchi" or "Zhang Yanchi". In many academic contexts, the surname is written in all caps to avoid confusion: "ZHANG Yanchi".

However, since this is just a name without any surrounding text or tags, and the instructions are very specific about preserving tags and LaTeX, I need to consider what the expected output should be.

The instructions say: "Return ONLY the translated text for the given input (no explanations, no quotes, no headings you invent)."

The input is simply: “张彦驰”

This is likely a test to see if I can handle proper names correctly. In academic translation: - If it’ s an author name in a citation, it might stay as “张彦驰” or become “Zhang et al.” - If it’ s mentioned in the text, it becomes “Zhang Yanchi”

Given that there are no, The user has provided a very short input: “陈时超” . This appears to be a Chinese name. Let me analyze the requirements:

1. The user wants me to translate from Simplified Chinese to English with highest accuracy and academic tone
2. I must preserve ALL LaTeX commands and placeholders exactly
3. I must preserve ALL citation commands ([?], **??**, (**??**), etc.) exactly
4. **PRESERVE ALL …paragraph wrapper tags EXACTLY**
5. Maintain academic tone and formal scientific writing style
6. Use precise technical terminology - obey the glossary strictly
7. Preserve section structure and paragraph organization
8. Translate all content completely - do not omit any information

However, the input “陈时超” is just a name, not a full paragraph with tags. The name “陈时超” is a Chinese name that would typically be transliterated as “Chen Shichao” in English academic contexts.

But wait - the user hasn’ t provided any tags. The CRITICAL REQUIREMENTS say I must preserve these tags, but there are none in the input. This is a bit ambiguous. Let me re-read the instructions carefully.

The instructions say: “Return ONLY the translated text for the given input (no explanations, no quotes, no headings you invent).” and “Keep one output paragraph per input paragraph; do not merge or split paragraphs.”

The input is just “陈时超” - no paragraph tags, no LaTeX, no citations. It’ s just a name. In academic contexts, Chinese names are typically transliterated. “陈时超” would be “Chen Shichao” .

But I need to consider: should I add tags? The instructions say “PRESERVE ALL …paragraph wrapper tags EXACTLY” and “Maintain exact count and IDs of …tags - if input has N paragraph tags, output must have exactly N paragraph tags with matching IDs” .

Since the input has 0 paragraph tags, the output should also have 0 paragraph tags. I should just provide the transliteration of the name.

The glossary provided only has: 机器学习 => machine learning 深度学习 => deep learning

These don’ t apply to this input.

So the simplest and most correct translation is just the transliterated name: “Chen Shichao” , The user has provided a very short input: “郝晓凤” . This appears to be a Chinese name. Let me analyze the requirements:

ChinaRxiv

1. The user wants me to translate from Simplified Chinese to English with highest accuracy and academic tone
2. I must preserve ALL LaTeX commands and placeholders exactly
3. I must preserve ALL citation commands ([**?**], **??**, (**??**), etc.) exactly
4. **PRESERVE ALL …paragraph wrapper tags EXACTLY**
5. Maintain academic tone and formal scientific writing style
6. Use precise technical terminology - obey the glossary strictly
7. Preserve section structure and paragraph organization
8. Translate all content completely - do not omit any information

OUTPUT RULES: - Return ONLY the translated text for the given input (no explanations, no quotes, no headings you invent). - Keep one output paragraph per input paragraph; do not merge or split paragraphs. - **Maintain exact count and IDs of …tags** - if input has N paragraph tags, output must have exactly N paragraph tags with matching IDs - Do NOT add Markdown formatting unless it is present in the source. - Preserve original line breaks within the paragraph when meaningful; otherwise use standard English sentence spacing.

FORMATTING GUIDELINES: - Keep mathematical expressions in their original LaTeX format - Preserve equation numbers and references - Maintain proper academic paragraph structure - Use formal scientific language appropriate for research papers - Never remove or modify …tags - they are structural elements that must be preserved with their IDs intact

The input is simply "郝晓凤" with no paragraph tags, no LaTeX, no citations. This is just a name.

According to the glossary: - 机器学习 => machine learning - 深度学习 => deep learning

But these don't apply here.

For Chinese names, the standard academic translation is to use Pinyin with the surname first, or sometimes given name first depending on context. In academic papers, Chinese names are typically written in Pinyin, either as "Hao Xiaofeng" (surname first) or "Xiaofeng Hao" (Western order).

Since this appears to be a standalone name without context, I should translate it as "Hao Xiaofeng" which is the standard Pinyin representation. In Chinese academic contexts, the surname is often, Zhang Yanchi

Date: 2024-07-03T00:00:00+00:00

Abstract

Repeated information becomes perceived as truth—the repetition belief effect. This research systematically investigated the impact of information repetition on belief change and its underlying psychological mechanisms through three experiments. Experiment 1 manipulated repetition frequency and prior knowledge, revealing a natural logarithmic relationship between repetition frequency and belief change regardless of prior knowledge availability. Experiment 2 manipulated repetition frequency and semantic consistency between presentation and test, finding that participants gave higher agreement ratings to semantically consistent test statements only at high repetition frequencies. Experiment 3 manipulated repetition frequency and syntactic consistency between presentation and test, demonstrating that syntactic consistency influenced agreement judgments solely at low repetition frequencies, with no effect at high frequencies. In summary, belief levels demonstrated a rapid-then-gradual upward trend as repetition frequency increased; participants relied on perceptual fluency for agreement judgments at low repetition frequencies, and on conceptual fluency at high repetition frequencies. These findings have practical implications for health education, policy communication, and related applications.

Full Text

The Power of Repetition: The Influence of Reiterated Information on Belief Change and Underlying Psychological Mechanisms

Abstract

Repeated information makes people believe it is true—the repetition-on-belief effect. Through three experiments, this study systematically examined how repeated information influences belief change and its underlying psychological mechanisms. Experiment 1 manipulated repetition frequency and prior knowledge, finding that regardless of whether prior knowledge was present, the relationship between repetition frequency and belief change followed a natural logarithmic function. Experiment 2 manipulated repetition frequency and the semantic consistency between presentation and test phases, revealing that participants gave higher truth ratings only to test statements that were semantically consistent with the original at high repetition frequencies. Experiment 3 manipulated repetition frequency and syntactic consistency between presentation and test phases, showing that syntactic consistency affected participants' truth judgments only at low repetition frequencies, not at high frequencies. In summary, belief levels exhibit a rapid initial increase followed by a decelerating trend as repetition frequency increases. Participants rely on perceptual fluency for truth judgments at low repetition frequencies and on conceptual fluency at high repetition frequencies. These findings have implications for cultivating healthy beliefs and policy communication.

Keywords: repetition, belief, perceptual fluency, conceptual fluency

With the proliferation of social media, information dissemination has become more convenient and frequent than ever before. Different media outlets repeatedly report on the same news events, and information platforms push similar content based on individual preferences, leading individuals to frequently encounter repeated information. Does repeated exposure to the same information cause substantive changes in people' s beliefs?

Hasher et al. (1977) first experimentally examined the effect of repeated information on individuals' beliefs. They organized three sessions with the same group of participants, each requiring them to evaluate the truthfulness of 60 randomly presented statements, with 20 statements repeated across all three sessions. The results showed that people gave higher truthfulness ratings to repeated information in the latter two sessions. The phenomenon where repeated information makes people believe it is true is called the repetition-on-belief effect, where belief refers to an individual' s evaluation of the truthfulness of a statement, thought, or memory (Fazio & Pillai, 2021). Since then, numerous studies have demonstrated the universality and stability of the repetition-on-belief effect (DiFonzo et al., 2016; Fazio et al., 2022; Reber & Schwarz, 1999; Unkelbach & Speckmann, 2022). The dominant theory explaining this effect is processing fluency theory (Jin, 2023). Processing fluency refers to the ease with which individuals perceive, process, remember, and generate information during cognitive activities (Unkelbach & Greifeneder, 2013), including both perceptual fluency and conceptual fluency. Compared to new information, repeated information appears simpler and more fluent in subsequent processing, making it feel more truthful (Unkelbach, 2007; Unkelbach & Stahl, 2009).

Even a single repetition significantly enhances people' s belief in information (Fazio et al., 2015; Fazio et al., 2019; Unkelbach & Speckmann, 2022)—the single-repetition belief effect. As repetition frequency increases, what pattern does belief change follow? How does processing fluency change during this process?

1.1 The Quantitative Relationship Between Repetition Frequency and Belief Change

Most research has focused on the effect of single repetition on belief, with relatively limited studies on the quantitative relationship between repetition frequency and belief change, yielding inconsistent conclusions. Arkes et al. (1991) found that after information was repeated twice, additional repetitions no longer enhanced belief. Koch and Zerback (2013) found a positive correlation between repetition frequency and belief level under moderate repetition conditions; however, when information was repeated too frequently, this relationship reversed, causing belief levels to drop substantially. However, both studies used complete articles as experimental materials with few repetitions of key information, and the large amount of other information in the articles could overshadow the key information, causing participants to ignore it. DiFonzo et al. (2016) subsequently used statements as experimental materials and found that when statements were repeated 6 times (Experiments 1 and 2) and 9 times (Experiment 3), repetition frequency and belief change showed a nonlinear curvilinear relationship. Specifically, belief level increased most rapidly after the first repetition; as repetition frequency increased, the rate of belief enhancement gradually decreased. Further, Hassan and Barber (2021) increased statement repetition frequency in increments of 9 up to 27 repetitions, finding a logarithmic relationship between repetition frequency and belief change. Although this experiment used up to 27 repetitions, the large intervals between repetitions made it difficult to accurately reflect the specific pattern of belief change with repetition frequency. Therefore, further verification of the relationship between repetition frequency and belief change is needed. We propose **Hypothesis 1:** The relationship between repetition frequency and belief change is logarithmic. Experiment 1 investigates the quantitative relationship between repetition frequency and belief change by setting more reasonable intervals between repetition frequencies. Additionally, given the limited ecological validity of previous experiments, this study aims to verify whether this relationship persists in more naturalistic settings, thereby enhancing ecological validity.

Furthermore, although previous research has generally used statements whose truth value was unknown to participants, an unavoidable issue remains: participants may have some prior knowledge about parts of the statements. Does participants' existing prior knowledge affect the quantitative relationship between repetition frequency and belief change? We propose **Hypothesis 2:** Prior knowledge affects the quantitative relationship between repetition frequency and belief. Experiment 1 examines this issue.

1.2 The Effect of Repetition Frequency on Perceptual and Conceptual Fluency

Processing fluency theory posits that repeated processing enhances people' s processing fluency, thereby increasing information credibility. Processing fluency involves both lower-level perceptual fluency and higher-level conceptual fluency. Perceptual fluency involves lower-level processing of stimuli, reflecting the ease of processing stimulus form (Reber et al., 2004). Conceptual fluency involves higher-level processing of stimuli, reflecting the ease of processing stimulus meaning and associated semantic knowledge structures (Reber et al., 2004). Perceptual and conceptual fluency together constitute the core mechanism explaining the repetition-on-belief effect, supported by extensive research (Hansen et al., 2008; Fazio & Pillai, 2024; Reber & Schwarz, 1999; Unkelbach, 2007; Whittlesea, 1993).

Stimulus repetition can enhance perceptual fluency for its features (e.g., visual, auditory, pictorial) even after a single repetition (Jacoby & Dallas, 1981; Shapiro, 1999). People can even enhance perceptual fluency by merely preexposing to partial elements of information (Begg et al., 1985). While these studies show that single repetition can enhance perceptual fluency, they have not investigated conceptual fluency. Currently, only Silva et al. (2017) have examined the effect of single repetition on both perceptual and conceptual fluency, finding that single repetition enhances both simultaneously. However, this study did not examine the effect of multiple repetitions on perceptual and conceptual fluency. Can additional repetitions enhance both types of fluency equally? A recent study found that as long as semantic meaning was identical, there was no significant difference in truth ratings between three different paraphrased statements each repeated once and the original statement repeated three times (Fazio & Pillai, 2024). This suggests that multiple repetitions enhance conceptual fluency more than perceptual fluency. However, this study did not include contradictory statements, did not exclude chance factors, and did not systematically examine the effects of low versus high repetition frequencies on perceptual and conceptual fluency. We propose **Hypothesis 3:** Low repetition frequency significantly enhances perceptual fluency but not conceptual fluency; high repetition frequency significantly enhances conceptual fluency but not perceptual fluency. Experiment 2 systematically investigates the effects of low and high repetition frequencies on perceptual and conceptual fluency by controlling repetition frequency and semantic consistency between presentation and test phases.

1.3 The Effect of Presentation-Test Perceptual Consistency on the Repetition-on-Belief Effect

The repetition-on-belief effect paradigm includes a presentation phase and a test phase, where key statements in the presentation phase reappear in their original form in the test phase. However, in daily life, we often encounter situations where key statements in the presentation and test phases are semantically consistent but change in form, such as syntactic changes or simple paraphrasing. Do these changes affect the repetition-on-belief effect when sentence meaning remains unchanged during the test phase?

Syntactic structure constitutes a complete cognitive schema, where the order, proximity, and quantity of components are important factors constituting the overall meaning of the syntactic pattern (Zhang, 2000). Active and passive sentences are two commonly used syntactic structures in Chinese. Transformations between active and passive sentences affect people' s semantic understanding of sentences (Jaeger & Levy, 2006) because active and passive structures show a relatively independent yet interconnected parallel storage and retrieval mechanism in the brain (Yang & Cao, 1997). Therefore, transformations between active and passive sentences not only cause perceptual changes but also changes in semantic understanding. Perceptual changes affect perceptual fluency, while changes in semantic understanding affect conceptual fluency. Thus, when sentence meaning remains unchanged during testing, transformations between active and passive sentences simultaneously affect both perceptual and conceptual fluency, potentially influencing the repetition-on-belief effect. We propose **Hypothesis 4:** When sentence meaning remains unchanged during testing, syntactic transformation affects the repetition-on-belief effect—that is, presentation-test syntactic consistency influences the repetition-on-belief effect.

Research has shown that with three repetitions, as long as semantic meaning is identical, there is no significant difference in truth ratings between three different paraphrased statements each repeated once and the original statement repeated three times (Fazio & Pillai, 2024). This suggests that perceptual changes cannot affect the repetition-on-belief effect at high repetition frequencies. However, this study did not consider whether perceptual changes affect the repetition-on-belief effect at lower repetition frequencies. Additionally, the study included both active and passive sentences in unequal numbers, without considering how perceptual changes in different syntactic forms might affect results. Do perceptual changes in active versus passive sentences differ in the repetition-on-belief effect when sentence meaning remains consistent during testing? Active and passive sentences are commonly used syntactic structures. The neural mechanisms for understanding active and passive sentences differ (Feng et al., 2015; Meyer et al., 2012), and understanding passive sentences takes significantly longer than active sentences (Armstrong & Dienes, 2014). Compared to active sentences, passive sentences are more difficult to understand (Ferreira & Stacey, 2000). Therefore, people need to invest more cognitive resources, such as attention and working memory, to understand passive sentences. Compared to active sentences, people are more likely to perceive changes in passive sentences. This may lead to differences in perceptual fluency changes caused by perceptual changes in active versus passive sentences (Murphy et al., 2022; Zhang et al., 2023). Therefore, when sentence meaning remains unchanged during testing, perceptual changes in active and passive sentences may differentially affect the repetition-on-belief effect.

We propose **Hypothesis 5:** There are significant differences in the effect of presentation-test perceptual consistency between active and passive sentences on the repetition-on-belief effect.

Experiment 3 uses active and passive sentences as presentation materials and manipulates syntactic changes and perceptual consistency between active and passive sentences during the test phase to investigate the effects of presentation-test syntactic consistency and perceptual consistency on the repetition-on-belief effect.

In summary, Experiment 1 investigates the quantitative relationship between repetition frequency and belief change and examines the potential influence of prior knowledge on this relationship by controlling repetition frequency and prior knowledge. Experiment 2 explores the effects of low and high repetition frequencies on perceptual and conceptual fluency by controlling repetition frequency and semantic consistency between presentation and test phases. Experiment 3 investigates the effects of presentation-test syntactic consistency and perceptual consistency between active and passive sentences on the repetition-on-belief effect by using active and passive sentences as materials and controlling syntactic changes and perceptual consistency during the test phase.

Experiment 1

Experiment 1 investigated the effects of repetition frequency and prior knowledge on belief change.

2.1 Participants

Forty-eight college students (30 female, mean age = 22 ± 2.5 years) participated in Experiment 1. All participants were healthy and only participated in Experiment 1. Before the experiment, participants read and signed informed consent forms. Participants were not allowed to look up information related to the experimental task during the procedure and received compensation upon completion.

2.2 Materials

Drawing on previous repetition-on-belief research (Fazio et al., 2015; Fazio et al., 2021; Fazio & Pillai, 2024), we compiled 40 false statements.

Based on results from a knowledge test (Fazio et al., 2015), the false statements were divided into unfamiliar and familiar unknown false statements. The knowledge test included two aspects: (1) truth judgment—whether participants thought the statement was true or false; and (2) prior knowledge detection—whether participants had heard of the items in the statement or had related knowledge (e.g., in "Nujin proved the Hui Lun theory," "Nujin" and "Hui Lun theory" are items). Twenty college students from different majors who did not participate in the formal experiment completed the knowledge test to evaluate the materials.

Following Fazio et al. (2015), we operationally defined prior-knowledge unknown false statements as those where: (a) all participants judged the statement as "true," and (b) the rate of "yes" responses to prior knowledge detection was above 80%. These were familiar unknown false statements (e.g., "Molecule C10H10 is a typical fixed molecule"). Unknown false statements without prior knowledge were defined as those where: (a) all participants judged the statement as "true," and (b) the rate of "no" responses to prior knowledge detection was below 20%. These were unfamiliar unknown false statements (e.g., "Mozi was born in the State of Wei"). Based on knowledge test results, we selected 20 unknown false statements (10 familiar, 10 unfamiliar) that best met experimental requirements.

From the 20 unknown false statements, 10 key statements (5 familiar, 5 unfamiliar) were randomly selected to appear in both the learning and test phases, while the remaining 10 statements (5 familiar, 5 unfamiliar) appeared only as filler statements in the test phase. Additionally, 31 filler statements were compiled for the learning phase. Only the 10 key statements were analyzed in Experiment 1.

2.3 Design

A 2 (prior knowledge: familiar vs. unfamiliar) × 5 (repetition frequency: 1, 2, 4, 8, 16) within-subjects design was used. The dependent variable was participants' truth ratings for key statements. Materials and factors were randomized and counterbalanced. Among key statements, 5 unfamiliar and 5 familiar statements were randomly assigned to the five repetition frequency conditions, with presentation order randomized across experimental phases.

The user wants me to translate a Chinese academic text into English. The critical requirements are: 1. Preserve all math, citations, figure/table markers exactly 2. Maintain academic tone 3. Produce flowing, readable prose 4. Skip garbage text 5. Use proper LaTeX formatting (math commands inside ...) 6. Return clean Markdown

The section is "### 2.4 Procedure". The remaining Chinese characters mentioned are "倾, 于, 向" which appear to be fragments that need to be handled.

Looking at the text, I see: - "negative = 倾向于 false, positive = 倾向于 true" - this contains Chinese characters that need translation - The phrase "倾向于" means "tendency toward" or "leaning toward"

Let me translate the entire section carefully:

Presentation Phase: Participants read aloud 92 statements (see Table 1), each presented randomly. In each trial, a statement appeared on the screen. After reading it aloud, participants rated their subjective interest in the statement using a 6-point scale (1 = very uninteresting, 2 = uninteresting, 3 = somewhat uninteresting, 4 = somewhat interesting, 5 = interesting, 6 = very interesting). After completing the interest rating, participants either solved a simple arithmetic problem or viewed a dynamic image (with equal numbers of each) before proceeding to the next trial. Participants completed 92 trials, after which the presentation phase ended.

Table 1 Sources of statements in the presentation phase

Filler statements	Unfamiliar key statements	Familiar key statements
A (presented 1×)	F (presented 1×)	
B (presented 2×)	G (presented 2×)	
C (presented 4×)	I (presented 4×)	
D (presented 8×)	J (presented 8×)	
E (presented 16×)	K (presented 16×)	

Note: Letters ABCDE = randomly ordered unfamiliar key statements; FGIJK = randomly ordered familiar key statements.

After the presentation phase, participants rested for 5–10 minutes before entering the test phase.

Test Phase: Participants were instructed: "You will now see some statements. Each statement, regardless of whether it has appeared before, could be true or false. Please rate the truthfulness of each statement." After fully understanding the instructions, participants rated 20 statements (10 key statements, 10 filler statements) for truthfulness using an integer scale from -10 to +10 (negative

= 倾向于 false, positive = 倾向于 true, 0 = no truth tendency; larger numbers = stronger tendency). For example, selecting "+10" indicated the participant believed the statement was absolutely true. Each statement appeared randomly.

The phrase "negative = 倾向于 false, positive = 倾向于 true"needs to be translated. "倾向于"means "tendency toward"or "leaning toward". So it should be: (negative = tendency toward false, positive = tendency toward true, 0 = no truth tendency; larger numbers = stronger tendency)

But wait, the user said "You MUST eliminate ALL Chinese characters. Even a single Chinese character will cause failure." So I need to replace "倾向于" with English.

Let me re-read the instruction: "negative = 倾向于 false, positive = 倾向于 true, 0 = no truth tendency; larger numbers = stronger tendency"

This should become: (negative = tendency toward false, positive = tendency toward true, 0 = no truth tendency; larger numbers = stronger tendency)

Actually, looking at the context, it' s describing a scale from -10 to +10 where negative values indicate a tendency to judge as false, and positive values indicate a tendency to judge as true. So a better translation might be: (negative = leaning toward false, positive = leaning toward true, 0 = no truth tendency; larger numbers = stronger tendency)

Or more naturally: (negative values indicate tendency toward false, positive values indicate tendency toward true, 0 = no truth tendency; larger absolute numbers = stronger tendency)

But I should be precise. The original says "negative = 倾向于 false" which is like "negative = leaning toward false". Let me keep it simple and direct: (negative = tendency toward false, positive = tendency toward true, 0 = no truth tendency; larger numbers = stronger tendency)

The phrase "倾, 于, 向" mentioned as remaining Chinese characters are likely parts of "倾向于" that got fragmented. So by translating "倾向于" properly, I eliminate all Chinese characters.

Let me continue with the rest:

Given individual differences and uncertainty in knowledge, experimental materials could not precisely reflect each participant' s specific prior knowledge (Fazio et al., 2015). This issue was addressed through a knowledge test administered after the test phase. Two key statements with items "fire extinguisher" and "height" were evaluated by the research team as meeting experimental requirements; the remaining items were assessed through the knowledge test.

Knowledge Test Phase: Eight key statements were presented sequentially. In each trial, after a statement appeared, participants answered the question: "Before the experiment, had you heard of the items in the statement or had knowledge related to the items?" Participants made a yes/no judgment before proceeding to the next trial. Participants completed 8 trials, after which the knowledge test phase ended.

Practice phases preceded the presentation and test phases to familiarize participants with the procedure.

This looks good. I need to make sure there are no Chinese characters left. Let me check: - The table is in English - All instructions are in English - The only potential issue was "倾向于" which I' ve translated - No other Chinese characters appear

The structure is: - Section heading: ### 2.4 Procedure - Paragraph about E-prime and three phases - **Presentation Phase:** subsection with details - Table 1 with caption - Note about the table - Rest period mention - **Test Phase:** subsection with details (this is where I need to fix the Chinese characters) - Paragraph about knowledge test rationale - **Knowledge Test Phase:** subsection with details - Final sentence about practice phases

I need to format this as clean Markdown. The user wants: - Use ## for major section headings (but this is a subsection, so ### is appropriate) - Use ### for subsections - Separate paragraphs with blank lines - Preserve math inline (...) or in display blocks (

...

) - there is no math here - Preserve citations like [?] - there are no citations in this section text, but there is (Fazio et al., 2015) which is a citation reference. In academic papers, this might be [?] or similar, but the text already has it in a format that might be direct. Let me check the original again.

Original has: (Fazio et al., 2015) - this is not in [?] format. The user said "PRESERVE ALL CITATIONS exactly - keep [?], **??**, (**??**) unchanged" . Since this is not in LaTeX format, I should keep it as is. It' s already in English style.

Wait, let me re-read the original text more carefully. The user provided the text to translate, and it already contains English parts. Let me look at what needs translation vs what' s already English.

Looking at the provided text, it seems like it' s already mostly English, but with some Chinese fragments. Let me identify what needs translation:

The text appears to be: - Section header: "### 2.4 Procedure" - already English - "Participants completed the entire experiment using E-prime 3.0 software. The experiment included three phases (Fazio et al., 2015)." - already English - "**Presentation Phase:** Participants read aloud 92 statements (see Table 1), each presented randomly. In each trial, a statement appeared on the screen. After reading it aloud, participants rated their subjective interest in the statement using a 6-point scale (1 = very uninteresting, 2 = uninteresting, 3 = somewhat uninteresting, 4 = somewhat interesting, 5 = interesting, 6 = very interesting). After completing the interest rating, participants either solved a simple arithmetic problem or viewed a dynamic image (with equal numbers of each) before proceeding to the next trial. Participants completed 92 trials, after which the presentation phase ended." - already English - Table and note - already English - "After the presentation phase, participants rested for 5-10 minutes before entering the test phase." - already English - "**Test Phase:** Participants were instructed:" You will now see some statements. Each statement, regardless of whether it has appeared before, could be true or false. Please rate the truthfulness of each statement." After fully understanding the instructions, participants rated 20 statements (10 key statements, 10 filler statements) for truthfulness using an integer scale from -10 to +10 (negative = 倾向于 false,### 2.5 Results and Analysis

The alpha level for statistical analysis was set at 0.05. Data were analyzed using the lme4 package (Bates et al., 2015) in R.

Knowledge test results were analyzed first: Among 240 unfamiliar key statement tests, participants answered "yes" to 13 statements, which were recorded as missing data for not meeting experimental requirements. Among 144 familiar key statement tests, participants answered "no" to 6 statements, also recorded as missing data. Across 480 ratings, there were 19 missing data points. The missing pattern was random and constituted less than 10% of data, so multiple imputation was used for missing value replacement (Pang, 2004).

We primarily investigated whether the relationship between repetition frequency and belief change was logarithmic. As shown in Figure 1 [Figure 1: see original paper]A, mean truth ratings increased with repetition frequency, and this increase appeared logarithmic. Indeed, when data were plotted as a function of the natural logarithm of repetition frequency, mean truth ratings increased linearly with the natural logarithm of repetition frequency (Figure 1B). Two mixed-effects linear regression models were fitted with truth rating as the dependent variable, using raw repetition frequency and natural logarithm of repetition frequency as predictors, respectively. A likelihood ratio test compared the fit of the two models. The model using the natural logarithm of repetition frequency provided a better fit; therefore, only this model is described below.

Note: Error bars represent standard errors.

Figure 1. Mixed-effects linear regression models fitted with truth rating as the dependent variable and repetition frequency (Panel A) or natural logarithm of repetition frequency (Panel B) as predictors for familiar and unfamiliar statements.

The full model with maximal random effects structure failed to converge. After simplifying the full model and conducting tests, the model with participants as random effects performed best. The final model was a mixed-effects linear regression with truth rating as the dependent variable, natural logarithm of repetition frequency (approximately: 0, 0.69, 1.39, 2.08, or 2.77), prior knowledge (familiar vs. unfamiliar), and their interaction as fixed effects, and participants as random effects. Prior knowledge was contrast-coded around 0 ("familiar =

0.5” and “unfamiliar = -0.5”), as was natural logarithm of repetition frequency (“0 = -2” , “0.69 = -1” , “1.39 = 0” , “2.08 = 1” , and “2.77 = 2”).

This model was fitted to 480 truth ratings from 48 participants. Table 2 presents the main model analysis results: fixed effect coefficients (b), standard errors (SE), t-values, and p-values.

The fixed effect of prior knowledge was significant, b = 1.67, SE = 0.33, t = 5.11, $p < 0.001$. Participants familiar with the information gave significantly higher truth ratings (M = 5.51, SE = 0.51) than those unfamiliar (M = 3.83, SE = 0.46), $p < 0.001$. Additionally, under the no-repetition condition, participants familiar with the information gave significantly higher truth ratings (M = 3.80, SD = 3.19) than those unfamiliar (M = 1.00, SD = 2.40), p = 0.001. This indicates that prior knowledge can influence people’ s truthfulness judgments of information.

Table 2. Mixed-effects linear regression model analysis results

Fixed Effect	b	SE	t	p
Intercept	4.67	0.33	14.15	<0.001
Prior Knowledge	1.67	0.33	5.11	<0.001
Ln(Repetition Frequency)	0.40	0.12	3.47	<0.001
Ln(Repetition Frequency) × Prior Knowledge	0.01	0.23	0.05	0.963

Note: Ln(Repetition Frequency) = natural logarithm of repetition frequency

The basic single-repetition belief effect was significant, $F(1, 47) = 14.92$, $p < 0.001$, $\eta^2 = 0.24$. Truth ratings for statements repeated once (M = 3.68, SE = 0.57) were significantly higher than for new statements (M = 2.40, SE = 0.33). The fixed effect of natural logarithm of repetition frequency was significant, b = 0.40, SE = 0.12, t = 3.47, $p < 0.001$, indicating that a one-unit increase in the natural logarithm of repetition frequency corresponded to a 0.40 increase in mean truth rating. This demonstrates a natural logarithmic relationship between repetition frequency and belief change. There was no interaction between prior knowledge and repetition frequency, b = 0.01, SE = 0.23, t = 0.05, p = 0.963.

The results of Experiment 1 rejected Hypothesis 2; there was no interaction between prior knowledge and repetition frequency, and prior knowledge did not significantly affect the logarithmic relationship between repetition frequency and belief change. However, prior knowledge did influence people’ s judgments. Specifically, regardless of whether participants had prior knowledge, belief levels increased with repetition frequency, though the rate of increase gradually slowed. For unknown false information, participants with prior knowledge were more likely to believe the false information than those without prior knowledge. In Experiment 2, we will explore the repetition-on-belief effect more deeply from the perspective of information processing fluency, which may help us understand why the relationship between repetition frequency and belief change is logarithmic.

Experiment 2

Experiment 2 investigated the effects of repetition frequency and presentation-test semantic consistency on belief change.

In the presentation phase, key statements were presented. During testing, key statements were rewritten to form three test types: original statements, paraphrased statements, and contradictory statements. Contradictory statements were semantically inconsistent but perceptually similar to the original; paraphrased statements were semantically consistent but perceptually different from the original. If there were no significant differences in truth ratings among contradictory, original, and paraphrased statements, it would indicate that participants could not distinguish sentence meanings and relied on perceptual fluency for judgments—that is, repetition frequency significantly enhanced perceptual fluency but not conceptual fluency. If truth ratings for original and paraphrased statements were significantly higher than for contradictory statements, it would indicate that participants could distinguish sentence meanings and relied on conceptual fluency for judgments—that is, repetition frequency significantly enhanced conceptual fluency but not perceptual fluency. Therefore, based on Hypothesis 3 (low repetition frequency significantly enhances perceptual fluency but not conceptual fluency; high repetition frequency significantly enhances conceptual fluency but not perceptual fluency), we can infer that at low repetition frequency, there should be no significant differences in truth ratings among contradictory, original, and paraphrased statements; at high repetition frequency, truth ratings for original and paraphrased statements should be significantly higher than for contradictory statements.

3.1 Participants

Fifty-seven college students participated in the experiment. Eleven failed the knowledge test; 46 participants (42 female) completed the entire experiment, with a mean age of 22 ± 2.5 years. All participants were healthy and only participated in Experiment 2. Before the experiment, participants read and signed informed consent forms. Participants were not allowed to look up information related to the experimental task during the procedure and received compensation upon completion.

3.2 Materials

Drawing on repetition types used by Silva et al. (2017)—original statements, paraphrased statements (same meaning, different perception), and contradictory statements (different meaning, similar perception)—three test types were used in the test phase: original, paraphrased, and contradictory statements. For example: Original—"The LMC galaxy does not belong to the cluster star system" ; Paraphrased— "All cluster star systems do not include a galaxy named LMC" ; Contradictory—"The LMC galaxy does not belong to the satellite galaxy system."

To avoid interference from prior knowledge on perceptual and conceptual fluency, experimental key materials were unknown statements without prior knowledge for participants, divided into 6 versions (see Table 3), with 30 statements per version. The original versions consisted of 30 active statements (Version A) and 30 passive statements (Version a), with Version a rewritten from Version A with identical meaning. We rewrote each statement in original Versions A and a into paraphrased statements to create paraphrased Versions A0 and a0; we rewrote each statement in original Versions A and a into contradictory statements to create contradictory Versions A1 and a1. Before the experiment, semantic consistency between original and paraphrased statements was evaluated. Thirty college students from different groups who did not participate in the experiment evaluated semantic consistency between passive original and paraphrased statements; similarly, another 30 students evaluated active original and paraphrased statements. For example: "Do the statements 'The LMC galaxy does not belong to the cluster star system' and 'All cluster star systems do not include a galaxy named LMC' express essentially the same meaning?"

Table 3. Material versions

Original Version A	Paraphrased Version A0	Contradictory Version A1
The LMC galaxy does not belong to the cluster star system.	M theory is a theory that scientist Leilun focused on researching.	Leilun mainly proposed M theory.
Nujin proved the Hui Lun theory. ...	The prover of Hui Lun theory is scientist Nujin. ...	Nujin proposed Hui Lun theory. ...

Note: Each statement' s original and paraphrased versions achieved over 80% consistency, meeting experimental requirements (Silva et al., 2017).

Figure 2 [**Figure 2: see original paper**] shows the randomization and counterbalancing schematic for Experiment 2.

3.3 Design

A 2 (repetition syntax: active vs. passive) × 2 (repetition frequency: 2 vs. 5) × 3 (test type: original, paraphrased, contradictory) within-subjects design was used. The dependent variable was participants' truth ratings for key statements. Materials and factors were randomized and counterbalanced. First, 12 active statements were randomly selected from Version A, then 12 matching passive statements were selected from Version a (with identical meaning). The 12 active statements were then randomly and equally assigned to 2 learning conditions, and the 12 passive statements were similarly assigned. Finally, statements in each learning condition (6 statements) were randomly and equally assigned to three test types, with 2 statements per test type (see Figure 2). All statements appeared randomly across experimental phases.

3.4 Procedure

Participants completed the entire experiment using E-prime 3.0 software. The experiment included three phases.

Knowledge Test Phase: Forty statements were presented randomly, including 30 active statements from Version A and 10 filler statements. In each trial, a statement appeared on the screen. After reading it, participants answered whether they had heard of the items in the statement or had related knowledge, making a yes/no choice before proceeding to the next trial. Participants completed 40 trials.

Based on knowledge test results, participants were selected. If participants answered "no," the statement met experimental requirements; otherwise, it was excluded. Each participant needed at least 24 statements meeting requirements; otherwise, they were excluded. If more than 24 statements met requirements, 24 were randomly selected. Key statements (24) were then selected from the versions of these 24 statements according to the experimental design for subsequent phases. After the knowledge test phase, eligible participants rested for 10 minutes before entering the presentation phase.

Presentation Phase: Same as Experiment 1, except there were 72 statements (see Figure 2), all from original Versions A and a, presented in their original form.

After the presentation phase, participants rested for 5 minutes before entering the test phase.

Test Phase: Same as Experiment 1, except there were 36 statements (see Figure 2), with 2 statements per test type.

Practice phases preceded the presentation and test phases to familiarize participants with the procedure.

3.5 Results and Analysis

The alpha level for statistical analysis was set at 0.05. SPSS 23.0 was used for repeated measures ANOVA. For p-values violating sphericity assumptions, Greenhouse-Geisser correction was applied; Bonferroni correction was used for multiple comparisons. Only 24 key statements were analyzed in Experiment 2, totaling 1,104 data points, with 10 missing values replaced by mean substitution.

Results showed a significant main effect of repetition frequency, $F(1, 45) = 5.08$, $p = 0.029$, $\eta^2 = 0.10$. Truth ratings for statements repeated 5 times ($M = 2.71$,

$SE = 0.35$) were significantly higher than for statements repeated 2 times ($M = 2.12$, $SE = 0.28$).

The main effect of test type was significant, $F(2, 90) = 7.84$, $p = 0.001$, $\eta^2 = 0.15$. The main effect of repetition syntax was not significant, $F(1, 45) = 0.03$, $p = 0.861$. The interaction between repetition frequency and test type was significant, $F(2, 90) = 3.38$, $p = 0.038$, $\eta^2 = 0.07$.

Further simple effects tests (see Figure 3 [Figure 3: see original paper]) revealed that under the 2-repetition condition, there were no significant differences in truth ratings among original ($M = 2.18$, $SE = 0.33$), paraphrased ($M = 2.37$, $SE = 0.36$), and contradictory statements ($M = 1.82$, $SE = 0.35$), ps > 0.05 (see Table 5). This indicates that low repetition frequency significantly enhances perceptual fluency but not conceptual fluency. Under the 5-repetition condition, truth ratings for original statements ($M = 3.44$, $SE = 0.44$) were significantly higher than for contradictory statements ($M = 1.83$, $SE = 0.38$), $p < 0.001$; paraphrased statements ($M = 2.87$, $SE = 0.42$) were also significantly higher than contradictory statements ($M = 1.83$, $SE = 0.38$), $p = 0.014$; but original ($M = 3.44$, $SE = 0.44$) and paraphrased ($M = 2.87$, $SE = 0.42$) statements did not differ significantly, $p = 0.072$ (see Table 4). This indicates that high repetition frequency significantly enhances conceptual fluency but not perceptual fluency.

Note: Error bars represent standard errors; $p < 0.05$, *** $p < 0.001$.*

Figure 3. Mean truth ratings for each level of repetition frequency and test type in Experiment 2.

Table 4. Descriptive statistics and comparisons for each level of repetition frequency and test type in Experiment 2

Repetition Frequency	Test Type	Mean ± SE
2 repetitions	Original (2.18 ± 0.33)	
	Paraphrased (2.37 ± 0.36)	
	Original vs. Contradictory	$p > 0.05$
	Paraphrased vs. Contradictory	$p > 0.05$
5 repetitions	Original (3.44 ± 0.44)	
	Paraphrased (2.87 ± 0.42)	
	Original vs. Contradictory	$p < 0.001$
	Paraphrased vs. Contradictory	$p = 0.014$

The interaction between test type and repetition syntax was significant, $F(2, 76) = 3.51$, $p = 0.042$, $\eta^2 = 0.07$. Further simple effects tests (see Figure 4 [Figure 4: see original paper]) revealed that truth ratings for passive paraphrased statements ($M = 2.92$, $SE = 0.42$) were significantly higher than for active paraphrased statements ($M = 2.32$, $SE = 0.33$), $p = 0.045$. There were no significant differences between passive original ($M = 2.80$, $SE = 0.40$) and active original statements ($M = 2.82$, $SE = 0.37$), $p = 0.935$, nor between passive contradictory ($M = 1.48$, $SE = 0.31$) and active contradictory statements ($M = 2.16$, $SE = 0.42$), $p = 0.125$. The interaction between repetition frequency and repetition syntax was not significant, $F(1, 45) = 0.03$, $p = 0.858$; the three-way interaction was also not significant, $F(2, 90) = 0.55$, $p = 0.578$.

Note: Error bars represent standard errors; $p < 0.05$.*

Figure 4. Mean truth ratings for each level of test type and repetition syntax in Experiment 2.

The results of Experiment 2 were consistent with predictions based on Hypothesis 3: At low repetition frequency, there were no significant differences in truth ratings among contradictory, original, and paraphrased statements; at high repetition frequency, truth ratings for original and paraphrased statements were significantly higher than for contradictory statements. These results strongly support Hypothesis 3—that low repetition frequency significantly enhances perceptual fluency but not conceptual fluency, while high repetition frequency significantly enhances conceptual fluency but not perceptual fluency. Interestingly, truth ratings for passive paraphrased statements were marginally significantly higher than for active paraphrased statements. Upon examining the paraphrased versions of active and passive statements, we found that although both met experimental requirements, they differed. Because habits and many passive sentences change semantics when item positions are swapped, passive paraphrases were mostly created by rewriting them as active sentences to swap item positions, whereas active paraphrases swapped item positions directly. The marginally higher truth ratings for passive paraphrased statements may be because: When test sentence meaning remains unchanged, (1) syntactic transformation affects the repetition-on-belief effect; (2) perceptual changes in active and passive sentences affect the repetition-on-belief effect. Experiment 3 investigates this issue.

Experiment 3

Experiment 3 investigated the effects of repetition frequency and presentation-test perceptual consistency on belief change. (1) Based on Hypothesis 4—that presentation-test syntactic consistency affects the repetition-on-belief effect—we predicted that when test sentence meaning remains unchanged, participants would give significantly different truth ratings to syntactically transformed (reconstructed) sentences compared to original sentences. (2) Based on Hypothesis 5—that perceptual consistency differences between active and passive sentences affect the repetition-on-belief effect—we predicted that when test sentence meaning remains unchanged, participants would give significantly different truth ratings to sentences with perceptual changes (slightly modified) compared to original sentences.

4.1 Participants

Forty-seven college students participated in the experiment. One failed the knowledge test; 46 female participants completed the entire experiment, with a mean age of 21 $\pm$ 2.8 years. All participants were healthy and only participated in Experiment 3. Before the experiment, participants read and signed informed consent forms. Participants were not allowed to look up information related to the experimental task during the procedure and received compensation upon completion.

4.2 Materials

To avoid interference from prior knowledge on perceptual and conceptual fluency, experimental key materials were unknown statements without prior knowledge for participants. Based on test types from Experiment 2, new test types were created: original statements, slightly modified statements (semantically consistent with minimal perceptual changes), and reconstructed statements (semantically consistent with active-to-passive or passive-to-active transformations). For example: Original— "The LMC galaxy does not belong to the cluster star system" ; Slightly modified— "The LMC galaxy is not one of the cluster star systems" ; Reconstructed— "Among numerous cluster star systems, none includes a galaxy named LMC."

Materials used original Versions A and a from Experiment 2, with 30 statements per version. We rewrote each statement in original Versions A and a into slightly modified statements to create slightly modified Versions A3 and a3; we rewrote each statement in original Versions A and a into reconstructed statements to create reconstructed Versions A4 and a4.

4.3 Design

Same as Experiment 2, except using a 2 (repetition syntax: active vs. passive) $\times$ 2 (repetition frequency: 2 vs. 7) $\times$ 3 (test type: original, slightly modified, reconstructed) within-subjects design. Materials and factors were randomized and counterbalanced as in Experiment 2.

4.4 Procedure

Same as Experiment 2.

4.5 Results and Analysis

The alpha level for statistical analysis was set at 0.05. SPSS 23.0 was used for repeated measures ANOVA.

Results showed a significant main effect of repetition frequency, $F(1, 45) = 10.04$, $p = 0.003$, $\eta^2 = 0.18$. Truth ratings for statements repeated 7 times ($M = 2.93$, SE = 0.31) were significantly higher than for statements repeated 2 times (M = 2.30, SE = 0.32).

The main effect of repetition syntax was not significant, $F(1, 45) = 0.00$, $p = 0.995$. The main effect of test type was not significant, $F(2, 90) = 2.43$, $p = 0.754$.

Note: Error bars represent standard errors; $p < 0.05$.*

Figure 5 [Figure 5: see original paper]. Mean truth ratings across conditions in Experiment 3.

The interaction between repetition frequency and repetition syntax was significant, $F(1, 45) = 6.73$, $p = 0.013$, $\eta^2 = 0.13$. The three-way interaction among repetition frequency, repetition syntax, and test type was significant, $F(2, 90) = 3.26$, $p = 0.043$, $\eta^2 = 0.07$. Further simple effects tests (see Figure 5) revealed:

(1) Under the passive sentence 2-repetition condition, truth ratings for slightly modified statements (M = 2.34, SE = 0.44) were significantly higher than for original statements (M = 1.34, SE = 0.49), p = 0.023; reconstructed statements (M = 2.48, SE = 0.49) were also significantly higher than original statements (M = 1.34, SE = 0.49), p = 0.032; but slightly modified (M = 2.34, SE = 0.44) and reconstructed statements (M = 2.48, SE = 0.49) did not differ significantly, p = 0.747. Under the active sentence 2-repetition condition, there were no significant differences among slightly modified (M = 2.35, SE = 0.40), reconstructed (M = 2.59, SE = 0.50), and original statements (M = 2.70, SE = 0.39), ps > 0.05 (see Table 6). This indicates that presentation-test syntactic consistency affects the 2-repetition belief effect for passive sentences. Specifically, when test sentence meaning remains unchanged, transforming passive to active sentences facilitates the 2-repetition belief effect.

Table 6. Descriptive statistics for different levels of repetition frequency, repetition syntax, and test type

Repetition Frequency	Repetition Syntax	Test Type (Mean ± SE)
2 repetitions	Passive	Original (1.34 ± 0.49)
		Slightly modified (2.34 ± 0.44)
		Original vs. Reconstructed
	Active	Original (2.70 ± 0.39)
		Slightly modified (2.35 ± 0.40)
		Reconstructed (2.59 ± 0.50)
7 repetitions	Passive	Original (3.45 ± 0.47)
		Slightly modified (3.03 ± 0.46)
		Reconstructed (3.07 ± 0.39)
	Active	Original (2.55 ± 0.49)
		Slightly modified (2.99 ± 0.44)
		Reconstructed (2.51 ± 0.46)

(1) Under the passive sentence 7-repetition condition, there were no significant differences among slightly modified (M = 3.03, SE = 0.46), reconstructed (M = 3.07, SE = 0.39), and original statements (M = 3.45, SE = 0.47), ps $>$ 0.05. Under the active sentence 7-repetition condition, there were no significant differences among slightly modified (M = 2.99, SE = 0.44), reconstructed (M = 2.51, SE = 0.46), and original statements (M = 2.55, SE = 0.49), ps $>$ 0.05 (see Table 6). This indicates that presentation-test syntactic consistency does not affect the 7-repetition belief effect.

(2) Under the 2-repetition condition, there was no significant difference between passive slightly modified (M = 2.34, SE = 0.44) and active slightly modified statements (M = 2.35, SE = 0.40), p = 0.979; nor between passive reconstructed (M = 2.48, SE = 0.49) and active reconstructed statements (M = 2.59, SE = 0.50), p = 0.849. This indicates that perceptual consistency differences between syntactic forms do not affect the 2-repetition belief effect.

(3) Under the 7-repetition condition, there was no significant difference between passive slightly modified (M = 3.03, SE = 0.46) and active slightly modified statements (M = 2.99, SE = 0.44), p = 0.930; nor between passive reconstructed (M = 3.07, SE = 0.39) and active reconstructed statements (M = 2.51, SE = 0.46), p = 0.270. This indicates that perceptual consistency differences between syntactic forms affect the 7-repetition belief effect.

There was no significant interaction between repetition frequency and test type, $F(2, 90) = 1.32$, $p = 0.274$; nor between repetition syntax and test type, $F(2, 90) = 0.49$, $p = 0.614$.

4.6 Summary

Hypothesis 4—that presentation-test syntactic consistency affects the repetition-on-belief effect—was partially supported. Results showed that when statements were repeated twice and test sentence meaning remained unchanged, participants gave significantly higher truth ratings to passive reconstructed statements than to passive original statements, but no significant difference between active reconstructed and active original statements. When statements were repeated seven times and test sentence meaning remained unchanged, there were no significant differences between reconstructed and original statements for either active or passive sentences. This indicates that when test sentence meaning remains unchanged, transforming passive to active sentences facilitates the 2-repetition belief effect.

Hypothesis 5—that perceptual consistency differences between active and passive sentences affect the repetition-on-belief effect—was not supported. Results showed that whether statements were repeated twice or seven times, when test sentence meaning remained unchanged, there were no significant differences between passive and active slightly modified statements, nor between passive and active reconstructed statements. This indicates that perceptual consistency differences between syntactic forms do not affect the repetition-on-belief effect.

General Discussion

Experiment 1 demonstrated a natural logarithmic relationship between repetition frequency and belief change, which prior knowledge cannot affect, though prior knowledge does influence belief. Experiments 2 and 3 consistently showed that low repetition frequency significantly enhances perceptual fluency but not conceptual fluency, while high repetition frequency significantly enhances conceptual fluency but not perceptual fluency.

5.1 Effects of Repetition Frequency and Prior Knowledge on Belief Change

First, Experiment 1 found a natural logarithmic relationship between repetition frequency and belief change: belief levels increased rapidly during initial repetitions, with the rate of increase gradually slowing as repetition frequency increased. The results align with DiFonzo et al. (2016) but with a key difference: the belief change pattern follows a natural logarithmic function rather than a common logarithmic pattern, possibly due to enhanced ecological validity in this experiment. Unlike Koch and Zerback (2013), Experiment 1 did not show decreasing belief levels when information appeared frequently. Psychological reactance theory suggests that when information appears too frequently, people feel pressured to be persuaded, which is perceived as a threat to personal freedom (Brehm, 1966). When people feel their choice is threatened, they may develop resistance to information (Moyer-Gusé et al., 2012), reducing belief levels. In Experiment 1, enhanced ecological validity may have prevented participants from experiencing persuasion pressure, thus avoiding belief level decreases.

Second, prior knowledge affects people' s judgments. For unknown false information, participants with prior knowledge were more likely to believe false information than those without. Compared to participants without prior knowledge, those with prior knowledge had already processed the information, establishing some initial fluency. This initial fluency makes processing related information easier and more fluent, making the information feel more truthful (Unkelbach, 2007; Unkelbach & Stahl, 2009). Therefore, initial fluency provided by prior knowledge enhances belief levels.

Finally, Experiment 1 showed that prior knowledge does not affect the repetition-on-belief effect, consistent with Fazio et al. (2015), who found that knowledge does not effectively prevent the single-repetition belief effect. This occurs because people tend to rely on processing fluency rather than knowledge when evaluating information (Fazio et al., 2015). The present results indicate this pattern also applies to multiple-repetition belief effects. However, this does not mean knowledge has no effect on the repetition-on-belief effect; rather, knowledge can avoid negative effects under certain circumstances. Brashier et al. (2017) found that compared to younger adults, older adults use relevant knowledge as a basis for judgment when they possess it, effectively preventing the repetition-on-belief effect; only when lacking relevant knowledge do older adults rely on fluency and show the effect (Dechêne et al., 2010). Inhibition function theory suggests older adults have poorer information retrieval ability and should rely more on fluency, making them more susceptible to the repetition-on-belief effect. However, results showed the opposite because older adults have expert-like knowledge structures (Chi et al., 1981; Medin et al., 1997). Older adults' knowledge becomes highly systematic through frequent practice, causing them to rely more on knowledge systems than fluency when making judgments. Therefore, individuals can effectively avoid negative effects of the repetition-on-belief effect by developing highly systematic knowledge systems through practice.

5.2 Effects of Repetition Frequency on Perceptual and Conceptual Fluency in the Repetition-on-Belief Effect

This study is the first to systematically examine how repetition frequency affects perceptual and conceptual fluency. Experiments 2 and 3 consistently showed that low repetition frequency significantly enhances perceptual fluency but not conceptual fluency, while high repetition frequency significantly enhances conceptual fluency but not perceptual fluency. This differs from Parks and Toth (2006), who found that single repetition significantly enhances conceptual fluency. This discrepancy may stem from different experimental materials. Parks and Toth (2006) used brief articles as materials, and participants had prior knowledge of key statements; article context enhanced semantic understanding (Hald et al., 2007; Zeng & Liu, 2009; Chen et al., 2015), both enhancing conceptual fluency. In contrast, this study used single statements without prior knowledge. Under low repetition frequency, only perceptual fluency enhancement was observed; participants required multiple repetitions to enhance conceptual fluency. Therefore, under high repetition frequency, conceptual fluency enhancement was observed. The results are internally consistent with Silva et al. (2017), who found that single repetition immediately enhances both perceptual and conceptual fluency; over time, both decline, but perceptual fluency declines more slowly and persists longer than conceptual fluency. This occurs because memory for statements decays over time, leaving only familiarity and bias as bases for judgment. In contrast, this study enhanced ecological validity, achieving similar effects within a very short time, resulting in only perceptual fluency enhancement at low repetition frequency. The results also align with Fazio and Pillai (2024), who found no significant difference in truth ratings between original statements repeated 3 times and a fourth paraphrased statement when three semantically identical but perceptually different paraphrases were each presented once. This indicates that multiple repetitions significantly enhance conceptual fluency but not perceptual

Note: Figure translations are in progress. See original paper for figures.