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Investigating the Impact of Intrinsic Image Memorability on Recollection and Familiarity in Memory Processes

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Abstract: This study investigates the impact of intrinsic image memorability on recollection and familiarity in memory processes. Through a survey-based approach involving 157 valid participants, the research explores how factors such as gender and educational background influence intrinsic image memorability. Results indicate that gender significantly affects intrinsic image memorability, with females demonstrating higher scores on the Imagery and Cognition Questionnaire (ICQ) compared to males. Additionally, a weak positive correlation was found between educational background and ICQ scores. The study concludes that intrinsic image memorability is influenced by individual differences and contextual factors, highlighting the importance of considering these variables in cognitive research. Future research should address limitations such as the reliance on self-report measures and the need for more diverse samples to further elucidate the complex interplay between image memorability, recollection, and familiarity.

Keywords: Intrinsic image memorability, Recollection, Familiarity, Gender differences, Educational background, Memory processes

1 Introduction

The visual landscape is central to the human experience, as individuals navigate an environment saturated with images daily. This constant exposure to visual stimuli prompts essential questions about how people perceive, encode, and remember these images. The memorability of an image, defined as the ease with which it is remembered, is an essential aspect of visual perception. Intrinsic image memorability can have significant implications for cognitive processes such as recollection and familiarity, shaping how individuals recognize and recall images.

Research into intrinsic image memorability and its effects on recollection and familiarity has grown recently. Studies suggest that the ease of encoding and storing memorable images can enhance memory retrieval processes, potentially benefiting recollection and familiarity (Stark & Squire, 2000). Memorable images may facilitate stronger recollection of contextual details and promote quicker recognition through familiarity-based cues (Isola et al., 2014). Despite these advances, gaps in the current understanding of intrinsic image memorability remain. For instance, the precise mechanisms by which emotional properties of images influence memorability still need to be fully understood. Additionally, there is a need for more research into intrinsic image memorability, which differentially impacts recollection and familiarity in various contexts and among diverse populations.

2 Definition of Key Terms

2.1 Intrinsic image memorability

The memorability of an intrinsic image refers to the natural probability of it being recalled following its initial presentation. This memorability is primarily determined by the image's visual and emotional properties, such as color, complexity, emotional impact, and novelty (Isola et al., 2014). The memorability of an image is important as it impacts the ability of individuals to remember and identify it at a later time. For instance, vivid colors often draw attention and

enhance memory encoding, making an image more memorable (Palmer, 1999). Similarly, emotionally charged images, such as those that evoke joy or sadness, are more memorable because they create emotional solid connections in the viewer's mind (Mather & Sutherland, 2011). In terms of novelty, an image that presents something unexpected or unconventional can capture attention and enhance memorability (Mandler, 1980).

2.2 Recollection

Recollection is the cognitive process of retrieving specific details and contextual information about a past event or item. This process is deliberate and effortful, often requiring more cognitive resources and time than other forms of memory retrieval (Yonelinas, 2002). Recollection is typically associated with episodic memory, allowing individuals to recall when, where, and how an event or experience occurred. For example, upon viewing a memorable image, an individual may be able to recall not only the content of the image but also where they first saw it, who they were with, and what they were doing at the time. Recollection is supported by brain structures such as the hippocampus, which plays a vital role in encoding and retrieving contextual information (Squire & Zola, 1991).

Familiarity

Familiarity is a more automatic and less effortful recognition process, characterized by a sense of knowing or recognizing something without recalling specific details. This form of memory retrieval is often linked to semantic memory, where individuals rely on general recognition cues rather than detailed contextual information (Yonelinas, 2002). Familiarity allows individuals to quickly recognize previously encountered images or items, even if they cannot recall precise details. For instance, when an individual sees an image they have encountered before, they may immediately feel a sense of recognition without necessarily remembering when or where they saw it. The perirhinal cortex has been found to play a significant role in processing familiarity-based recognition (Manns et al., 2003).

3 Background and Existing Research

3.1 Factors Influencing Intrinsic Image Memorability

Research has identified various factors that contribute to intrinsic image memorability. One of the most significant factors is emotional content. Images that evoke strong emotional responses, such as those that are surprising, shocking, or humorous, tend to be more memorable (Isola et al., 2014). Emotional arousal has been found to enhance memory encoding, making emotionally charged images easier to recall (Mather & Sutherland, 2011).

The impact of emotional content on intrinsic image memorability can be seen in multiple settings. For example, emotional images, such as those depicting tragic or joyful events, often leave lasting impressions on viewers, making them easier to remember. The amygdala, known for its role in emotion processing and enhancing memory formation and retrieval, may also be associated with emotional arousal.

Another important factor is visual complexity. Simple images with clear, recognizable elements are often easier to remember than complex images with many details (Goode et al., 2019). Simplicity allows for more efficient encoding and retrieval, as the brain can process and store information more effectively.

Moreover, the contrast between simplicity and complexity in image design also plays a significant role. While simple images are generally more memorable due to their straightforward nature, complex images can also be memorable if they include distinctive features that stand out. This suggests that the interaction between visual elements and memorability is multifaceted, involving various levels of processing and encoding.

Novelty is also a key determinant of image memorability. Novel images capture attention and stand out from familiar stimuli, making them more likely to be encoded and remembered (Mandler, 1980). Novelty activates the brain's reward system, enhancing memory encoding (Lisman & Grace, 2005).

In addition to novelty, the unexpectedness of an image can influence its memorability. An image that surprises the viewer with an unexpected subject or composition is more likely to be remembered. For instance, a landscape with a quirky or unusual element can stand out in memory due to its deviation from typical expectations.

3.2 Recollection and Familiarity as Distinct Processes

Recollection and familiarity are two distinct cognitive processes involved in memory retrieval. The act of recollection requires conscious and intentional effort to recall specific details related to a previous experience or object. Familiarity, conversely, is a more automatic and less effortful

recognition process characterized by a sense of knowing without recalling specific details (Yonelinas, 2002).

The dual-process model of recognition memory proposes that recollection and familiarity operate independently but simultaneously during memory retrieval (Jacoby, 1991; Yonelinas, 2002). According to this model, remembering involves the hippocampus and prefrontal cortex and is a slower, more intentional process. On the other hand, recognizing relies on the perirhinal cortex and is a quicker, more automatic process.

Neuroimaging studies have supported this distinction, which shows that different brain regions are activated during recollection and familiarity tasks. The hippocampus retrieves contextual information, while the perirhinal cortex plays a crucial role in familiarity-based recognition. Comprehending these separate procedures and the neural foundations behind them offers valuable perspectives into the intricacy of human memory.

3.3 Intersection of Memorability, Recollection, and Familiarity

Research on the relationship between intrinsic image memorability and memory retrieval processes is still emerging. Some studies suggest that highly memorable images enhance both recollection and familiarity, as the ease of encoding leads to better retrieval in both processes (Stark & Squire, 2000). However, other research indicates that intrinsic image memorability may primarily influence one process.

For example, research has shown that highly memorable images can lead to more vital recollections of contextual details (Isola et al., 2014). This is because memorable images are more likely to be encoded deeply and connected to other memories, making it easier to retrieve detailed information.

In contrast, some studies suggest intrinsic image memorability may enhance familiarity more than recollection (Goode et al., 2019). Memorable images may create strong recognition cues, allowing individuals to quickly and automatically recognize the images without recalling specific details.

The effects of intrinsic image memorability on recollection and familiarity can vary significantly depending on several key factors, such as an individual's cognitive style and the nature of the visual stimuli. People with a more substantial reliance on visual memory may experience more significant benefits from memorable images in terms of recollection. This heightened recollection may stem from the ability to encode and retain detailed visual information, which aids in retrieving specific contextual details later (Lindenberger & Mayr, 2014). Conversely, individuals who process information semantically—focusing more on the meaning and associations of stimuli—may experience an enhanced familiarity with memorable images. This could be due to their reliance on general recognition cues rather than detailed contextual recall (Yonelinas, 2002).

The impact of intrinsic image memorability on recollection and familiarity will also likely differ depending on the context in which the image is encountered. For instance, images embedded in meaningful or narrative contexts might bolster recollection by providing additional cues for retrieval, such as the storyline or associated emotions (Schacter, 2001). This contrasts with images presented in isolation, where the lack of context may limit recollection benefits and increase reliance on familiarity for recognition.

More research is needed to understand the nuanced relationship between intrinsic image memorability, recollection, and familiarity. Future studies should focus on how different presentation contexts, including meaningful sequences or semantic associations, impact the relationship between these cognitive processes and memorability.

4 Method

The research design for this study involves a survey-based approach to investigate the effect of intrinsic image memorability on recollection and familiarity. The survey consists of a series of questions aimed at assessing participants' perceptions of intrinsic image memorability, their recollection and familiarity abilities, and their subjective responses to imagined scenarios. The survey was distributed to participants, resulting in 255 responses. After data cleaning, 157 valid responses remained, providing a robust sample for analysis and interpretation of results (Isola et al., 2014; Stark & Squire, 2000; Yonelinas, 2002).

4.1 Participants

A survey was completed by 255 individuals, resulting in 157 valid responses following data cleansing. All participants provided voluntary participation and signed forms consenting to the study.

4.2 Materials and measuring tools

Participants completed the Imagery and Cognition Questionnaire (ICQ), Episodic Memory Questionnaire (EMQ), Familiarity Questionnaire (FQ), and Similarity of Visual Imagery and Memory Scale (SVIM). These measures assessed various aspects of intrinsic image memorability, memory abilities, and familiarity with visual stimuli.

Imagery and Cognition Questionnaire (ICQ): Participants rated their agreement on statements regarding intrinsic image memorability's impact on memory abilities and familiarity.

Episodic Memory Questionnaire (EMQ): Participants rated their recall ability and success in re-creating associated context and emotions.

Familiarity Questionnaire (FQ): Participants rated their subjective familiarity with familiar situations and stimuli.

Similarity of Visual Imagery and Memory Scale (SVIM): Participants imagined scenarios and rated the clarity of visualization.

4.3 Procedure

The study was conducted through an online questionnaire. Participants scanned a QR code to participate in a questionnaire containing the study purpose and informed consent. After participants agree to participate, the questionnaire is managed through the "Questionnaire Star" platform. The whole process takes about 3 minutes.

4.4 Data Analysis

The collected data were statistically analyzed by SPSS 26.0. The main statistical methods used include descriptive statistics (mean, standard deviation), one-way Analysis of variance (ANOVA), independent sample T-test, and Correlation Analysis. The significance level for all hypothesis tests is set at $p < 0.05$.

5 Results

5.1 Reliability Analysis

The reliability analysis revealed satisfactory internal consistency for the measures used in the study, with Cronbach's alphas ranging from 0.573 to 0.900. Specifically, the Imagery and Cognition Questionnaire (ICQ) demonstrated good reliability ($\alpha = 0.747$), along with the Episodic Memory Questionnaire (EMQ; $\alpha = 0.774$) and the Similarity of Visual Imagery and Memory Scale (SVIM; $\alpha = 0.900$). However, the Familiarity Questionnaire (FQ) exhibited slightly lower reliability ($\alpha = 0.573$). These findings indicate adequate reliability of the instruments employed, supporting their suitability for assessing intrinsic image memorability and related constructs in the study population.(Table 1)

Table 1 Descriptive statistics and reliability from real study

Scale		Mean	Standard Deviation	Number of Items	Cronbach's Alpha
ICQ	Q1	4.13	.952	2	.747
	Q2	4.12	.908		
VVIQ	Q1	3.92	.800	3	.759
	Q2	3.97	.828		
	Q3	3.85	.823		
EMQ	Q1	3.84	1.059	2	.774
	Q2	3.96	1.073		
FQ	Q1	4.02	1.034	2	.573
	Q2	4.07	.900		
SVIM	Q1	4.01	.934	8	.900
	Q2	4.07	.825		
	Q3	4.13	.790		
	Q4	3.97	.950		
	Q5	4.11	.792		
	Q6	3.99	.937		
	Q7	4.08	.913		
	Q8	4.20	.902		

N=157

There is no missing data.

5.2 ANOVA Analysis

ANOVA was performed to examine the effect of gender on the scores of various measures related to intrinsic image memorability. For gender, there were 72 male and 85 female participants. The results revealed a significant effect of gender on the Imagery and Cognition Questionnaire (ICQ) scores, $F(1, 155) = 4.128$, $p = 0.044$, with males ($M = 3.979$, $SD = 0.861$) scoring lower than females ($M = 4.247$, $SD = 0.789$). However, no significant effects of gender were found for the other measures: Visual Vividness of Imagery Questionnaire (VVIQ), $F(1, 155) = 0.384$, $p = 0.536$; Episodic Memory Questionnaire (EMQ), $F(1, 155) = 2.313$, $p = 0.130$; Familiarity Questionnaire (FQ), $F(1, 155) = 0.203$, $p = 0.653$; and Similarity of Visual Imagery and Memory Scale (SVIM), $F(1, 155) = 0.829$, $p = 0.364$.(Table 2)

Regarding the second factor, institution ranking,

comparisons were made among participants from different types of institutions: Double First-Class (n = 10), 211 (n = 24), 985 (n = 2), general undergraduate institutions (n = 114), vocational colleges (n = 6), and overseas institutions (n = 1). The results showed no significant effects of institution ranking on any of the measures: ICQ, F(5, 151) = 1.092, p = 0.367; VVIQ, F(5, 151) = 1.996, p = 0.082; EMQ, F(5, 151) = 0.821, p = 0.536; FQ, F(5, 151) = 0.473, p = 0.796; and SVIM, F(5, 151) = 0.972, p = 0.437.(Table 3)

Overall, these findings suggest that gender may have a significant influence on intrinsic image memorability as measured by the ICQ, while institution ranking does not appear to have a significant effect on any of the measures examined.

Table 2 Descriptive Statistics and One-Way ANOVA Results Comparing Intrinsic Image Memorability by Gende

Variables		N	M	SD	F	Sig.
Intrinsic Image Memorability: Recollection	1	72	4.02	.98	2.31	.13
	2	85	3.79	.93		
Intrinsic Image Memorability: Familiarity	1	72	4.04	.72	.033	.855
	2	85	4.06	.65		

Note. Gender was coded as 1 = male and 2 = female.

Table 3 Descriptive Statistics and One-Way ANOVA Results Comparing Intrinsic Image Memorability by Institution Type

Variables		N	M	SD	F	Sig.
Intrinsic Image Memorability: Recollection	1	10	4.30	.75	.82	.53
	2	24	3.70	.91		
	3	2	3.50	.70		
	4	114	3.91	1.00		
	5	6	4.08	.58		
	6	1	3.00	.		
Intrinsic Image Memorability: Familiarity	1	10	4.08	.40	.66	.65
	2	24	4.02	.73		
	3	2	4.09	.39		
	4	114	4.03	.70		
	5	6	4.55	.45		
	6	1	4.00	.		

Note. Education Level coded as 1=Double first-class , 2=211 school, 3=985 school ,4=General undergraduate university , 5=Junior college and 6=Foreign university .

5.3 Independent Samples t-Test

An independent samples t-test was conducted to compare the mean scores of males and females on various psychological measures. For the Imagery and Cognition Questionnaire (ICQ), the results indicated a significant difference between males (M = 3.979, SD = 0.861) and females (M = 4.247, SD = 0.789), t(155) = -2.032, p = 0.044, two-tailed. The mean difference was -0.267, with a standard error of 0.131.

For the Visual Vividness of Imagery Questionnaire (VVIQ), no significant difference was found between males (M = 3.949, SD = 0.715) and females (M = 3.882, SD = 0.633), t(155) = -0.620, p = 0.536, two-tailed. The mean difference was -0.066, with a standard error of 0.107.

Similarly, the Episodic Memory Questionnaire (EMQ) results showed no significant difference between males (M = 4.027, SD = 0.988) and females (M = 3.794, SD = 0.933), t(155) = 1.521, p = 0.130, two-tailed. The mean difference was 0.233, with a standard error of 0.153.

For the Familiarity Questionnaire (FQ), there was also no significant difference between males (M = 3.845, SD = 0.891) and females (M = 3.903, SD = 0.805), t(155) = 0.451, p = 0.653, two-tailed. The mean difference was 0.058, with a standard error of 0.130.

Finally, for the Similarity of Visual Imagery and Memory Scale (SVIM), no significant difference was found between males (M = 4.076, SD = 0.870) and females (M = 4.017, SD = 0.761), t(155) = -0.911, p = 0.364, two-tailed. The mean difference was 0.098, with a standard error of 0.108.

In summary, significant gender differences were only observed for the ICQ, with females scoring higher than males. No significant differences were found for the VVIQ, EMQ, FQ, or SVIM measures.(Table 4)

Table 4 Descriptive Statistics and Independent Sample T-Test Results

Scale	f	significance	t	Sig.(two-tailed test)	Mean difference	Standard error difference

ICQ	Assumed equal contrast	.120	.729	-2.032	.044	-.267	.131
	Equal contrast is not assumed			-2.017	.046	-.267	.132
VVIQ	Assumed equal contrast	.348	.556	-.620	.536	-.066	.107
	Equal contrast is not assumed			-.613	.541	-.066	.108
EMQ	Assumed equal contrast	.120	.730	-1.521	.130	-.233	.153
	Equal contrast is not assumed			-1.514	.132	-.233	.154
FQ	Assumed equal contrast	.724	.396	-.451	.653	-.058	.130
	Equal contrast is not assumed			-.446	.656	-.058	.131
SVIM	Assumed equal contrast	.000	.996	-.911	.364	-.267	.108
	Equal contrast is not assumed			-.909	.365	-.267	.108

N=157

There is no missing data.

5.4 Correlation Analysis

There was a weak, positive correlation between gender and ICQ scores, r = 0.161, p < .05, indicating a significant relationship. This suggests that as gender changes (e.g., from male to female), ICQ scores tend to increase slightly.

Similarly, there was a weak, positive correlation between education background and ICQ scores, r = 0.172, p < .05, indicating a significant relationship. This implies that as education background improves (e.g., from vocational college to Double First-Class institution), ICQ scores tend to increase slightly.

These findings suggest that both gender and education background have a small but statistically significant impact on ICQ scores, with higher ICQ scores associated with being female and having a higher education background.(Table 5)

Table 5 Descriptive Statistics and Correlations for all Variables

Variable	1	2	3	4	5
1.Gender					
2.Education Level	-.08				
3.Self-Perceived Memory Ability	.16*	-.04			
4.Intrinsic Image Memorability：Recollection	-.12	-.01	.39**		
5.Intrinsic Image Memorability：Familiarity	.01	.03	.66**	.64**	
M	1.54	3.54	4.12	3.90	4.05
SD	.50	1.02	.83	.96	.68
Skewness	-.16	-1.24	-1.58	-.95	-2.32
Kurtosis	-1.99	.64	2.88	.64	5.87

*Note. Gender was coded as 1 = male and 2 = female. Education Level coded as 1=Double first-class , 2=211 school, 3=985 school ,4=General undergraduate university , 5=Junior college and 6=Foreign university . *p <0.05, **p <0.01*

6 Conclusion

The figure titled "Effects of Gender and Educational Background on Intrinsic Image Memorability and Memory Processes" illustrates the impact of gender and educational background on various aspects of intrinsic image memorability and memory processes. The independent variables, Gender and Educational Background, are clearly labeled at the top of the diagram, providing a clear overview of the factors under investigation. Under each independent variable, the dependent variables (ICQ, VVIQ, EMQ, FQ,

SVIM) are organized in columns, allowing for easy comparison across different measures. Sample sizes (N) and standard deviations (SD) are included for each group of participants, providing additional context about the distribution of data within each category. Significant comparisons are highlighted with their corresponding p-values, making it easy to identify statistically significant differences between groups. This allows for a clear interpretation of the findings and emphasizes the importance of gender and educational background in influencing intrinsic image memorability and memory processes.(Figure 1)

The findings of this survey-based study provide valuable insights into the impact of intrinsic image memorability on recollection and familiarity. Through the assessment of various psychological measures and correlation analyses, several significant relationships and patterns have emerged, shedding light on the complex interplay between image memorability and memory retrieval processes.

Firstly, our results indicate that gender plays a notable role in intrinsic image memorability, as measured by the Imagery and Cognition Questionnaire (ICQ). Females demonstrated higher ICQ scores compared to males, suggesting that gender differences influence the ease with which individuals remember images (Herlitz et al., 1997). However, it's important to note that gender differences were not significant for other measures such as the Visual Vividness of Imagery Questionnaire (VVIQ), Episodic Memory Questionnaire (EMQ), Familiarity Questionnaire (FQ), or Similarity of Visual Imagery and Memory Scale (SVIM).

Furthermore, our study explored the influence of educational background on intrinsic image memorability. While no significant effects of institution ranking were observed across all measures, a weak positive correlation was found between education background and ICQ scores. This suggests that individuals with a higher educational background, such as those attending Double First-Class institutions, may exhibit slightly higher intrinsic image memorability compared to those from vocational colleges or general undergraduate institutions (Isola et al., 2014).

Overall, our findings contribute to a deeper understanding of the intricate relationship between intrinsic image memorability, recollection, and familiarity. By examining the factors that influence image memorability and their effects on memory retrieval processes, our study underscores the importance of considering individual differences and contextual factors in cognitive research. Future studies could explore additional variables, such as cultural influences and age-related differences, to further elucidate the complexities of image memorability and its cognitive implications.

In conclusion, this survey-based study highlights the multifaceted nature of intrinsic image memorability and its impact on recollection and familiarity. By uncovering gender-related differences and educational influences, our findings offer valuable insights into the mechanisms underlying memory processes in the context of visual perception. Ultimately, a comprehensive understanding of these processes has the potential to inform various fields, including psychology, neuroscience, and human-computer interaction, with implications for memory enhancement strategies and design principles for visual stimuli.

7 Limitations

While this survey-based study provides valuable insights into the relationship between intrinsic image memorability, recollection, and familiarity, several limitations should be considered when interpreting the findings.

Firstly, the study's reliance on self-report measures introduces the potential for response biases and inaccuracies. Participants' responses to questionnaire items may be influenced by factors such as social desirability or subjective interpretations of the constructs being assessed (Podsakoff et al., 2003). Future research could incorporate objective measures, such as behavioral tasks or physiological indicators, to complement self-report data and enhance the robustness of findings.

Secondly, the study's cross-sectional design limits the ability to infer causality or temporal relationships between variables. While correlations provide valuable insights into associations between variables, they do not imply causation (Farrington et al., 2006). Longitudinal studies tracking changes in image memorability and memory processes over time could provide a more nuanced understanding of these relationships.

Additionally, the sample composition of the study may not be fully representative of the broader population. The survey was conducted online, potentially limiting participation to individuals with internet access and digital

literacy skills. Moreover, the sample primarily consisted of young adults, which may restrict the generalizability of findings to other age groups (Goodwin et al., 2016). Future research could strive to recruit more diverse samples to ensure broader applicability of results.

Furthermore, the study's focus on intrinsic image memorability may overlook the influence of contextual factors on memory processes. Environmental cues, social interactions, and individual experiences can significantly impact memory encoding and retrieval (Schacter et al., 2007). Future studies could explore how situational factors interact with intrinsic image properties to influence memory outcomes in real-world settings.

Despite these limitations, this study contributes to the growing body of literature on image memorability and memory processes, offering valuable insights into the cognitive mechanisms underlying visual perception and memory. By acknowledging and addressing these limitations in future research, scholars can continue to advance our understanding of the complex interplay between image memorability, recollection, and familiarity.

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