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Behavioural Science Study on Investor Behaviour in the Virtual Asset Markets: Heuristics in Virtual Assets Investment Decision-Making

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1. Title of the Project

Behavioural Science Study on Investor Behaviour in the Virtual Asset Markets: Heuristics in Virtual Assets Investment Decision-Making

2. Research Objectives

This study aims to understand various behavioural factors (specifically heuristics) that have a significant effect on investors' investment decisions in the virtual assets (or crypto) market in Hong Kong.

3. Research Design

Data collection for this study is piggybacked on a survey conducted by the Investor and Financial Education Council among virtual asset investors in October/November 2022. The survey sample consists of 501 virtual asset investors aged 18–69 (defined as individuals who have traded or held cryptocurrencies, stablecoins, non-fungible tokens or securities tokens in the past 12 months). The breakdown of the sample is as follows:

		Frequency	Percentage
Age	18–29	169	34
	30–39	215	43
	40–69	117	23
Gender	Male	359	72
	Female	142	28
Education	Secondary or below	107	21
	Tertiary or above	394	79
Monthly personal income	< \$20K	78	16
	\$20–29K	208	42
	\$30–49K	135	27
	\$50K+	61	12
	Refused	19	4
	TOTAL	501	100

4. Concept of Heuristics

Heuristics are mental shortcuts or rules of thumb that assist in making decisions and judgements in times of uncertainty.

As shortcuts or rules, heuristics should not be viewed as inherently bad; there are pros and cons to their implementation. On the one hand, heuristics are quick and easy to use, allowing for judgements and decisions when time or cognitive capacity is limited. The downside, however, is that they can often be inaccurate, leading to systemic errors or biases in judgement. While heuristics clearly have the advantage of helping investors to 'think fast', these rules of thumb can, on occasion, lead to poor, suboptimal or irrational decisions made with biases when overemployed as a decision-making strategy.

5. Measurement

Thirteen items depicting different behavioural tendencies, implying behavioural economics or heuristic factors, are included in the main questionnaire.

It is important to emphasise that while each statement has been assigned to one particular key heuristic principle, it is likely that each behavioural tendency could be attributed to different interpretations and is, therefore, associated with different heuristics and biases. Thus, the key heuristics and the other heuristics/biases should not be seen as mutually exclusive.

Key heuristics	Other possible heuristics & biases	Statements in questionnaire		
Anchoring	Gamblers' fallacy; Representativeness	a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。
Anchoring	Mental accounting; Loss aversion; Sunk-cost fallacy; Disposition effect; Prospect theory	d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。
Availability	Fear of missing out	l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。

Key heuristics	Other possible heuristics & biases	Statements in questionnaire		
Availability	Herding (social proof)	h)	Other investors' decisions on virtual assets volume have an impact on my investment decisions.	其他投資者投資虛擬資產的 <u>交易量</u> 會影響我的投資決定。
Anchoring	Sunk cost fallacy; Loss aversion; Confirmation bias; Optimism; Disposition effect	m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。
Representative-ness	Availability; Recency bias	j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。
Availability	Herding (social proof)	i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。
Availability	Herding (social proof)	g)	Other investors' decisions on choosing virtual asset types have an impact on my investment decisions.	其他投資者選擇虛擬資產的 <u>類型</u> 會影響我的投資決定。
Availability	Authorities	k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。
Overconfidence	Optimism; Confirmation bias	b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。
Overconfidence	Optimism; Confirmation bias	f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。
Mental accounting	Prospect theory; House money effect	c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時

Key heuristics	Other possible heuristics & biases	Statements in questionnaire		
				追求更高風險的投資。
Mental accounting	Prospect theory; Fear uncertainty and doubt (Loss aversion)	e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。

6. EXECUTIVE SUMMARY

6.1 At the itemmetric level (which is based on the five selected types of heuristics tested in this study as outlined on p. 3):

While there are various classifications of heuristics, we mainly focus on the following heuristic principles which are most relevant to investors' behaviour (e.g., Yalcin et al., 2016) and the virtual assets market (e.g. Hidajat, 2019):

- **Anchoring** and **Availability** heuristics, which are the top two mental shortcuts or rules adopted by virtual asset investors:
- **Anchoring** refers to people making decisions based on the initial reference point or the very first set of information they get. This has a priming effect whereby initial exposure to an anchor serves as a false reference point and influences subsequent judgements about value. In the context of Virtual Asset investing this can manifest as relying on previous experiences in the market when making future investment decisions, where said previous experience is the first set of information an investor has received, serving as an anchor to prime future decisions.
- **Availability** refers to people making decisions and judgements based on the ease with which information and thoughts can be brought to mind. Things that are easy to recall (based on familiarity, vividness or recency) enjoy more salience and influence our decision-making more strongly. In the context of Virtual Asset investing an example of this can include an investor's decision to buy or sell a virtual asset based on their recollection of other investors' buying or selling virtual assets. This is because this piece of information is based on familiarity and recency which is more familiar and easily brought to mind in comparison to information such as market informed research.
- **Representativeness** – People consider as likely an event that is more representative and similar to an existing mental prototype (Tversky & Kahneman, 1974), or make decisions based on past events or traits that are representative of or similar to the current situation. For example, the probability that a new cryptocurrency will produce returns is judged based on whether it resembles previous lucrative cryptocurrencies. Misjudgments can also be based on the historical prices of the particular virtual assets.
- **Overconfidence** – People can overestimate their ability, knowledge and skills and believe that they are able to earn a higher return (Waweru et al., 2008). This can take the form of the illusion of control, illusion of knowledge, self-attribution bias or overoptimism. Investors who are too sure of their investment ability may make risky investment decisions.
- **Mental accounting** – This is the tendency to separate one's money into different mental accounts based on subjective criteria such as source or commitment, and to assign different mental values to the same sum of money. As an example, investors tend to invest using mental compartmentalisation, and consider their assets separately, failing to see interactions between different asset classes (Thaler, 2008). Investors holding virtual assets across wallets might find it difficult to keep track relative to their broader financial portfolio.

- Here are the top 5 heuristic statements endorsed by the surveyed investors:

Statements in Questionnaire			Key Heuristics
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability
h)	Other investors' decisions on virtual assets <u>volume</u> have an impact on my investment decisions.	其他投資者投資虛擬資產的 <u>交易量</u> 會影響我的投資決定。	Availability
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring

- As outlined in the literature, gender differences in the use of heuristics are very prominent:
 - Female virtual asset investors are more likely to implement **Availability (in both Herding and Authority effects)** (statements g, i and k) and **Mental accounting (in terms of Loss aversion)** (statement e)
 - Male investors, however, may be subject to **Overconfidence** (statements b and f) and **Mental accounting (or the related House money effect)** (statement c).
- Frequency of Trading (or the level of engagement with virtual asset investment) emerges as another key predictor in the use of decision heuristics:
 - More frequent traders tend to be **self-confident or Overconfident** (statements b and f)
 - Less frequent traders are more prone to **Mental accounting (as in Loss aversion)** (statement e), **Availability (as in Authorities)** (statement k), **Availability (as in Herding)** (statements h, i and g), **Anchoring (with possibilities of other biases)** (statement d), **Representativeness** (and possibly **Availability as in Recency bias**) (statement j)
- Investors who have different virtual asset allocations or different balances in their investment portfolio can also be subject to the effects of various heuristic rules:
 - Investors with a higher proportion of virtual assets (in liquid assets) tend to subscribe to **Mental accounting (as in House money effect)** (statement c), **Availability (as in Fear of missing out)** (statement l), **Anchoring (and other possible biases)** (statement m), **Anchoring (possibly with Gamblers' fallacy and Representativeness)** (statement a) and **Representativeness (and possibly Availability as in Recency bias)** (statement j)
 - In contrast, investors with a lower proportion of virtual assets (in liquid assets) tend to associate with **Overconfidence** (statements b and f), **Availability (as in Herding)** (statements g and i) and **Mental accounting (as in Loss aversion)** (statement e)

- The higher the level of perceived risk in virtual asset products, the more investors subscribe to ***Herding***, but move away from ***Anchoring, Representativeness*** (and possibly ***Availability in terms of Recency bias***) and ***Overconfidence***.

6.2 At the factorial level (factor analysis is carried out to highlight interrelationships among items and group items that are part of certain concepts):

- Five heuristic strategies on virtual asset investment are identified:
- **Strategy 1 – Herding** (investors make decisions based on other investors' decisions)
- **Strategy 2 – Secure obedience** (investors make decisions based on authority figures rather than their own skills and knowledge, possibly due to lower risk tolerance after prior losses)
- **Strategy 3 – Distrustful empiricism** (investors rely on their own personal experiences, both previous and recent, rather than long-term objective data)
- **Strategy 4 – Wishful speculation** (investors tend to speculate by holding onto assets with decreased value)
- **Strategy 5 – Intuitive confidence** (investors tend to believe strongly in their personal insights and intuition)
- Males tend to be associated with the heuristic strategies of ***Intuitive confidence*** and ***Distrustful empiricism***, relying on their own intuition and past experience. Females tend to adhere to ***Secure obedience*** and ***Herding***, which means they are highly influenced by experts and other investors, which gives them peace of mind.
- More frequent traders (or those with higher engagement) appear to alienate themselves from the heuristic strategies of ***Secure obedience, Herding, Wishful speculation*** and ***Distrustful empiricism***. In other words, less-engaged investors (they could be beginners or passive) are more susceptible to various heuristic strategies instead.
- Investors with a higher proportion of virtual assets (in liquid assets) tend to associate with increased use of heuristic strategies such as ***Distrustful empiricism*** and ***Wishful speculation***, but decreased use of ***Herding***. They focus on their own past experiences rather than other investors, and hope for rebounds in their investment with decreased value.
- Last but not least, investors with a higher level of perceived risk in virtual asset products seem to be less vulnerable to ***Wishful speculation*** and ***Intuitive confidence***, and appear to be more in touch with the market reality.

**** For detailed explanations of different Heuristics, please refer to the Glossary of terms in the Appendix.***

7. KEY FINDINGS

The findings are reported in the following two main sections:

- An itemmetric-level analysis and reporting;
- A factorial-level analysis and reporting (factor analysis is carried out to highlight interrelationships among items and group items that are part of certain concepts)

7.1 Itemmetric-Level Analysis

To answer the very first question of which heuristic techniques predict investment decision-making on virtual assets, an itemmetric analysis was carried out for the different statements. In the following table, items are presented in descending order of level of agreement.

It appears that **Anchoring** and **Availability** heuristics are top mental shortcuts or rules used by virtual asset investors. This is followed by **Representativeness**, **Overconfidence** and **Mental accounting**. For detailed explanations of different heuristics, please refer to the Glossary of terms in the Appendix.

Table 1

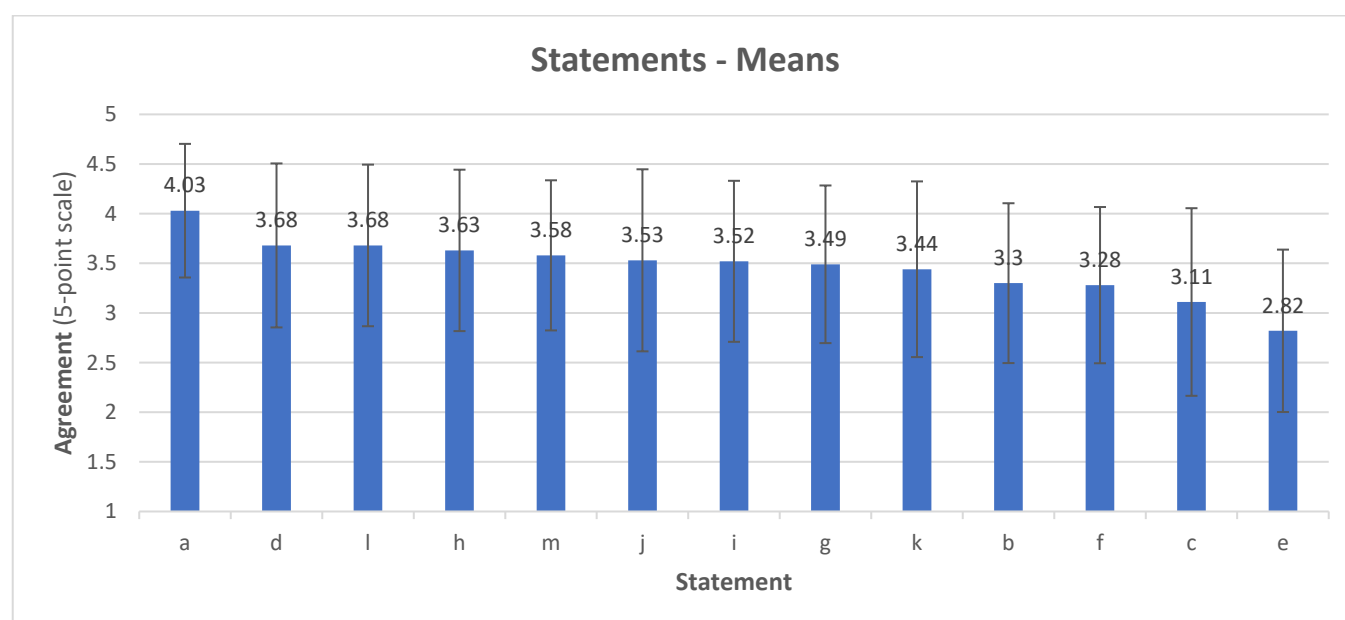
Means and SDs of Agreement with Statements (rated on a 5-point scale where 5 denotes 'strongly agree' and 1 denotes 'strongly disagree')

Statements in questionnaire			Key heuristics	Strongly disagree (%)	Disagree (%)	Neither (%)	Agree (%)	Strongly agree (%)	Mean	SD
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	0.4	2.6	11.2	65.7	20.2	4.03	0.67
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	0.2	10.0	24.0	53.3	12.6	3.68	0.83

Statements in questionnaire			Key heuristics	Strongly disagree (%)	Disagree (%)	Neither (%)	Agree (%)	Strongly agree (%)	Mean	SD
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	0.2	10.0	23.0	55.3	11.6	3.68	0.81
h)	Other investors' decisions on virtual assets volume have an impact on my investment decisions.	其他投資者投資虛擬資產的 交易量 會影響我的投資決定。	Availability	0.2	12.2	20.2	58.9	8.6	3.63	0.81
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	0	9.4	30.1	53.5	7.0	3.58	0.76
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representative-ness	0.4	15.2	28.1	43.1	13.2	3.53	0.92
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	0.2	13.6	26.5	53.5	6.2	3.52	0.81
g)	Other investors' decisions on choosing virtual asset types have an impact on my investment decisions.	其他投資者選擇虛擬資產的 類型 會影響我的投資決定。	Availability	0.4	14.2	25.3	56.5	3.6	3.49	0.79
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	2.4	12.2	32.1	45.9	7.4	3.44	0.89

Statements in questionnaire			Key heuristics	Strongly disagree (%)	Disagree (%)	Neither (%)	Agree (%)	Strongly agree (%)	Mean	SD
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Overconfidence	2.0	12.8	42.1	39.9	3.2	3.30	0.81
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。	Overconfidence	3.0	8.8	49.1	35.9	3.2	3.28	0.79
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	2.2	28.7	29.5	35.1	4.4	3.11	0.95
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	1.8	38.3	36.5	23.0	0.4	2.82	0.82

Figure 1
Means and SDs of Agreement with Statements



The following analyses zoom into the different demographic variables and other investment or virtual asset-related variables as predictors in the level of use of heuristics in decision-making.

7.1.1 DEMOGRAPHIC VARIABLES

Gender and Decision Heuristics

Most of the literature points towards gender differences in investment strategies, indicating that women are relatively more conservative and risk-averse, favour safer investment options and have lower confidence in their investment decisions.

Consistent with such findings, female virtual asset investors tend to subscribe to **Availability (in both Herding and Authority effects)** (statements g, i and k) and **Mental accounting (in terms of Loss aversion)** (statement e) to a greater extent (highlighted in green in Table 2). Male investors, however, may be subject to **Overconfidence** (statements b and f) and **Mental accounting (or the related House money effect)** (statement c) (highlighted in orange in Table 2). For detailed explanations of different heuristics, please refer to the Glossary of terms in the Appendix.

Table 2

Gender differences in Agreement with Statements

Statements			Key heuristics	Male (N = 359)		Female (N = 142)		ANOVA
				Mean	SD	Mean	SD	F (1, 499)
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	4.06	0.66	3.94	0.70	2.97
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Overconfidence	3.40	0.77	3.02	0.84	24.05 **
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	3.18	0.91	2.93	1.00	7.14 **
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	3.67	0.84	3.70	0.80	0.16

Statements			Key heuristics	Male (N = 359)		Female (N = 142)		ANOVA	
				Mean	SD	Mean	SD	F (1, 499)	
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	2.75	0.82	2.98	0.79	7.73	**
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。	Overconfidence	3.35	0.76	3.09	0.82	11.03	**
g)	Other investors' decisions on choosing virtual asset types have an impact on my investment decisions.	其他投資者選擇虛擬資產的 類型 會影響我的投資決定。	Availability	3.42	0.80	3.65	0.76	8.25	**
h)	Other investors' decisions on virtual assets volume have an impact on my investment decisions.	其他投資者投資虛擬資產的 交易量 會影響我的投資決定。	Availability	3.60	0.82	3.73	0.78	2.87	
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	3.46	0.84	3.66	0.72	6.22	*
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representative-ness	3.55	0.92	3.51	0.91	0.18	
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎么做。	Availability	3.38	0.87	3.57	0.91	4.53	*
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	3.67	0.83	3.70	0.77	0.08	
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	3.58	0.75	3.59	0.77	0.04	

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Age and Decision Heuristics

Overall, age is not found to be a highly significant predictor of the use of heuristics. Little difference exists between the different age groups in terms of subscribing to heuristics pertaining to investment.

The following table shows the mean scores when we consolidate the sample into three age brackets, with a significant effect of age on statement c. There is clearly a decline in the momentary surge in risk appetite after gaining or winning with increasing age: from 18–29 ($M = 3.26$) to 40–69 ($M = 2.96$). This may indicate the higher influence of **Mental accounting** (in terms of **House money effect**) (statement c) among younger investors (highlighted in orange in Table 3).

Table 3

Age differences in Agreement with Statements (3 age groups)

Statements			Key heuristics	18–29 (N = 169)	30–39 (N = 215)	40–69 (N = 117)	ANOVA
				Mean	Mean	Mean	F (2, 498)
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	4.02	4.05	3.99	0.25
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能和知識可以幫助我跑贏大市。	Overconfidence	3.18	3.37	3.32	2.59
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	3.26	3.07	2.96	3.91 *

Statements			Key heuristics	18–29 (N = 169)	30–39 (N = 215)	40–69 (N = 117)	ANOVA
				Mean	Mean	Mean	F (2, 498)
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	3.79	3.60	3.68	2.57
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	2.79	2.84	2.82	0.21
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。	Overconfidence	3.23	3.29	3.32	0.46
g)	Other investors' decisions on choosing virtual asset <u>types</u> have an impact on my investment decisions.	其他投資者選擇虛擬資產的 <u>類型</u> 會影響我的投資決定。	Availability	3.59	3.43	3.44	2.23
h)	Other investors' decisions on virtual assets <u>volume</u> have an impact on my investment decisions.	其他投資者投資虛擬資產的 <u>交易量</u> 會影響我的投資決定。	Availability	3.66	3.62	3.62	0.09
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	3.60	3.47	3.50	1.24
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representativeness	3.56	3.54	3.48	0.30

Statements			Key heuristics	18–29 (N = 169)	30–39 (N = 215)	40–69 (N = 117)	ANOVA
				Mean	Mean	Mean	F (2, 498)
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	3.54	3.39	3.38	1.89
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	3.72	3.71	3.58	1.15
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	3.62	3.57	3.56	0.27

* significant $p \leq 0.05$

The pattern of **Mental accounting** remains the same if we adhere to the original breakdown of five age groups.

Table 4

Age Differences in Agreement with Statements (5 age groups)

Statements			Key heuristics	18–29 (N = 169)	30–39 (N = 215)	40–49 (N = 69)	50–59 (N = 46)	60–69 (N = 2)
				Mean	Mean	Mean	Mean	Mean
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	3.26	3.07	3.06	2.83	2.5

Education Level and Decision Heuristics

Investors with a higher education level tend to be more **self-confident (or Overconfident)** (statement b). Still, they are more subject to **Availability (in terms of Herding – volume)** (statement h) (highlighted in green in Table 5).

On the other hand, investors with lower education levels display a higher tendency to **Representativeness** (and possibly **Availability in terms of Recency bias**), as indicated in statement j. They also tend to report **Anchoring** in not selling virtual assets with decreased value and readily sell assets with increased value (statement d) (highlighted in orange in Table 5). This may suggest the possibilities of various underlying biases such as **Mental accounting**, **Sunk-cost fallacy**, **Loss aversion** and **Disposition effect**. For detailed explanations of different heuristics, please refer to the Glossary of terms in the Appendix.

Table 5

Education and Agreement with Statements

Statements			Key heuristics	Juni or seco ndar y (N = 1)	Seni or seco ndar y (N = 106)	Colle ge/ asso. deg. (N = 187)	Bach elor (N = 180)	Mast er or abov e (N = 27)	ANOVA
				Mean	Mean	Mean	Mean	Mean	F (4, 496)
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	4.00	4.12	4.03	3.99	3.89	0.96
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Overconfidence	4.00	3.20	3.20	3.42	3.48	2.78 *
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	3.00	3.19	3.10	3.06	3.15	0.32

Statements			Key heuristics	Juni or seco ndar y (N = 1)	Seni or seco ndar y (N = 106)	Colle ge/ asso. deg. (N = 187)	Bach elor (N = 180)	Mast er or abov e (N = 27)	ANOVA
				Mean	Mean	Mean	Mean	Mean	F (4, 496)
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	3.00	3.80	3.70	3.66	3.26	2.57 *
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	2.00	2.95	2.81	2.79	2.56	1.73
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。	Overconfidence	4.00	3.19	3.22	3.35	3.48	1.65
g)	Other investors' decisions on choosing virtual asset types have an impact on my investment decisions.	其他投資者選擇虛擬資產的 類型 會影響我的投資決定。	Availability	2.00	3.51	3.47	3.49	3.52	0.93
h)	Other investors' decisions on virtual assets volume have an impact on my investment decisions.	其他投資者投資虛擬資產的 交易量 會影響我的投資決定。	Availability	2.00	3.57	3.64	3.62	4.07	3.25 *
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	2.00	3.50	3.49	3.54	3.70	1.32
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representative- ness	3.00	3.70	3.64	3.33	3.59	3.91 **

Statements			Key heuristics	Juni or seco ndar y (N = 1)	Seni or seco ndar y (N = 106)	Colle ge/ asso. deg. (N = 187)	Bach elor (N = 180)	Mast er or abov e (N = 27)	ANOVA
				Mean	Mean	Mean	Mean	Mean	F (4, 496)
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	3.00	3.48	3.42	3.41	3.63	0.53
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	3.00	3.74	3.65	3.73	3.33	1.78
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	4.00	3.57	3.58	3.64	3.26	1.58

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Personal Income and Decision Heuristics

Similar to the age factor, personal income does not appear to be a very strong predictor of the use of numerous heuristics.

Having said that, investors with a higher monthly personal income tend to be **self-confident (or Overconfident)**, subscribing to statement b (highlighted in green in Table 6).

On the other hand, lower-income investors also tend to report **Anchoring** in not selling virtual assets with decreased value and readily sell assets with increased value (statement d) (highlighted in orange in Table 6). This may, again, suggest the possibilities of various underlying biases such as **Mental accounting**, **Sunk-cost fallacy**, **Loss aversion** and **Disposition effect**.

When using the original income brackets (instead of consolidating into three levels), it appears that investors with lower income tend to subscribe to **Anchoring**, conforming to **Authority** figures to a slightly larger extent as in statement k (highlighted in orange in Table 7).

Table 6

Income Level and Agreement with Statements (3 levels)

Statements			Key heuristics	< HK\$ 15k– 19k (N = 78)	HK\$ 20k– \$49k (N = 343)	HK\$ 50k– \$99k (N = 61)	ANOVA
				Mean	Mean	Mean	F (2, 476)
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	4.13	4.05	3.90	2.25
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Overconfidence	3.04	3.34	3.57	8.29 **
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	3.31	3.10	3.03	1.89
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	3.86	3.67	3.51	3.17 *
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	2.90	2.80	2.70	0.97
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。	Overconfidence	3.22	3.29	3.38	0.71
g)	Other investors' decisions on choosing virtual asset types have an impact on my investment decisions.	其他投資者選擇虛擬資產的 類型 會影響我的投資決定。	Availability	3.55	3.48	3.46	0.31
h)	Other investors' decisions on virtual assets volume have an impact on my investment decisions.	其他投資者投資虛擬資產的 交易量 會影響我的投資決定。	Availability	3.64	3.64	3.59	0.09

Statements			Key heuristics	< HK\$ 15k–19k (N = 78)	HK\$ 20k–\$49k (N = 343)	HK\$ 50k–\$99k (N = 61)	ANOVA
				Mean	Mean	Mean	F (2, 476)
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	3.58	3.50	3.49	0.28
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representativeness	3.63	3.53	3.43	0.83
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	3.53	3.40	3.38	0.70
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	3.85	3.65	3.57	2.37
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	3.56	3.60	3.46	0.89

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Table 7

Income Level and Agreement with Statements (6 levels)

Statements			Key heuristics	< HK\$1 5k (N = 1)	HK\$1 5k–\$19k (N = 77)	HK\$2 0k–\$29k (N = 208)	HK\$3 0k–\$49k (N = 135)	HK\$5 0k–\$69k (N = 55)	HK\$7 0k–\$99k (N = 6)	ANOVA
				Mean	Mean	Mean	Mean	Mean	Mean	F (5, 476)
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Over-confidence	2.00	3.05	3.26	3.45	3.51	4.17	5.51 **

Statements			Key heuristics	< HK\$1 5k (N = 1)	HK\$1 5k– \$19k (N = 77)	HK\$2 0k– \$29k (N = 208)	HK\$3 0k– \$49k (N = 135)	HK\$5 0k– \$69k (N = 55)	HK\$7 0k– \$99k (N = 6)	ANOVA
				Mean	Mean	Mean	Mean	Mean	Mean	F (5, 476)
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	2.00	3.55	3.49	3.27	3.45	2.67	2.85 *

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

7.1.2 WEALTH AND INVESTMENT RELATED VARIABLES

Liquid Assets and Decision Heuristics

The liquid assets in the questionnaire are recoded into four levels for analytic purposes: below HK\$200k, HK\$200k–500k, HK\$500k–1m and HK\$1m or above.

Investors with more liquid assets have a higher tendency to display **Overconfidence** (statement b) (highlighted in green in Table 8).

In contrast, investors with fewer liquid assets subscribe to **Availability**, both in terms of **Authority bias** (statement k) and **Fear of missing out** (statement l). They also tend to report **Anchoring** in not selling virtual assets with decreased value and readily sell assets with increased value (statement d) (highlighted in orange in Table 8). This may, again, suggest the possibilities of various underlying biases such as **Mental accounting**, **Sunk-cost fallacy**, **Loss aversion** and **Disposition effect**.

Other significant differences (statements g and i) are less linear and pertain to particular subgroups only.

Table 8

Liquid Assets and Agreement with Statements

Statements			Key heuristics	< HK\$ 200k (N = 53)	HK\$ 200k – 500k (N = 229)	HK\$ 500k –1m (N = 205)	> HK\$ 1m (N = 14)	ANOVA
				Mean	Mean	Mean	Mean	F (3, 497)
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	4.00	3.98	4.09	4.00	0.99
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Overconfidence	2.79	3.27	3.43	3.64	10.45 **
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	3.13	3.08	3.13	3.14	0.10
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	4.08	3.65	3.60	3.79	4.90 **
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	2.92	2.89	2.71	2.79	2.07
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。	Overconfidence	3.06	3.28	3.31	3.43	1.71
g)	Other investors' decisions on choosing virtual asset <u>types</u> have an impact on my investment decisions.	其他投資者選擇虛擬資產的 <u>類型</u> 會影響我的投資決定。	Availability	3.34	3.61	3.40	3.43	3.34 *
h)	Other investors' decisions on virtual assets <u>volume</u> have an impact on my investment decisions.	其他投資者投資虛擬資產的 <u>交易量</u> 會影響我的投資決定。	Availability	3.43	3.68	3.62	3.79	1.51
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	3.30	3.66	3.42	3.36	4.92 **

Statements			Key heuristics	< HK\$ 200k (N = 53)	HK\$ 200k – 500k (N = 229)	HK\$ 500k –1m (N = 205)	> HK\$ 1m (N = 14)	ANOVA
				Mean	Mean	Mean	Mean	F (3, 497)
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representative-ness	3.51	3.50	3.61	3.07	1.77
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	3.72	3.48	3.32	3.36	3.19 *
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	4.15	3.64	3.61	3.57	6.89 **
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	3.81	3.52	3.58	3.71	2.24

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Experience of Trading/Investing in Virtual Assets and Decision Heuristics

Those with more experience in trading/investing in virtual assets tend to be more **self-confident or Overconfident**, as in statement b. Subscription to this overconfidence increased steadily from those with less than a year's experience ($M = 3.00$) to those who have 6–10 years of experience ($M = 3.49$) (highlighted in green in Table 9).

Investors with more experience in virtual assets appeared to be less susceptible to **Mental Accounting**, while being more 'immune' to both the **House money effect** (statement c) and **Loss aversion** (statement e). Agreement with these statements decreases steadily from those with less than a year's experience ($M = 3.37$) to those who have 6–10 years of experience ($M =$

2.80) (for statement c) and from those with less than a year's experience ($M = 3.37$) to those with over 10 years of experience ($M = 2.43$) (for statement e) (highlighted in orange in Table 9).

While there are also statistically significant differences among investors with varying levels of experience for statements g and m, the relationship with experience does not appear to be very clear or straightforward.

Table 9

Experience in Virtual Assets and Agreement with Statements

Statements			Key heuristics	< 1 year (N = 30)	1–3 year s (N = 248)	4–5 year s (N = 175)	6–10 year s (N = 41)	> 10 year s (N = 7)	ANOVA
				Mean	Mean	Mean	Mean	Mean	F (4, 496)
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	4.03	4.05	4.02	3.95	3.71	0.60
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Overconfidence	3.00	3.17	3.47	3.49	3.43	5.26 **
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	3.37	3.19	3.03	2.80	2.86	2.54 *
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	3.87	3.71	3.59	3.71	4.00	1.28
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	3.37	2.85	2.70	2.80	2.43	4.86 **
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。	Overconfidence	3.27	3.29	3.27	3.15	3.57	0.54
g)	Other investors' decisions on choosing virtual asset <u>types</u> have an impact on my investment decisions.	其他投資者選擇虛擬資產的 <u>類型</u> 會影響我的投資決定。	Availability	3.43	3.56	3.47	3.12	3.57	2.88 *

Statements			Key heuristics	< 1 year (N = 30)	1-3 year s (N = 248)	4-5 year s (N = 175)	6-10 year s (N = 41)	> 10 year s (N = 7)	ANOVA
				Mean	Mean	Mean	Mean	Mean	F (4, 496)
h)	Other investors' decisions on virtual assets volume have an impact on my investment decisions.	其他投資者投資虛擬資產的 <u>交易量</u> 會影響我的投資決定。	Availability	3.83	3.65	3.61	3.46	3.86	1.09
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	3.57	3.53	3.53	3.39	3.29	0.45
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representative-ness	3.63	3.57	3.49	3.54	2.86	1.25
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	3.53	3.47	3.41	3.32	3.29	0.44
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	4.00	3.64	3.67	3.80	3.14	2.33
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	3.33	3.52	3.70	3.61	3.43	2.40 *

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Frequency of Trading and Decision Heuristics

Similar to the above finding on more experienced investors, those who have traded virtual assets more frequently in the past 12 months tend to be more **self-confident or Overconfident**, as in statements b and f. For these statements, the respective means increase from $M = 3.10$ (for those with 1–5 transactions in P12M) to $M = 4.00$ (for those with over 30 transactions), and from $M = 1.17$ (for those with 0 transactions in P12M) to $M = 3.57$ (for those with over 30 transactions) (highlighted in green in Table 10).

These frequent traders tend to subscribe to some other heuristics to a lesser extent. In other words, those who traded less frequently may be more prone to:

- **Mental accounting (as in Loss aversion)** (statement e): The tendency to risk aversiveness after prior losses declines from those with 1–5 transactions in P12M ($M = 3.17$) to those with over 30 transactions in P12M ($M = 2.39$) (highlighted in orange in Table 10).
- **Availability (as in Authorities)** (statement k): Conformity to authority figures declines from those with 1–5 transactions in P12M ($M = 3.63$) to those with over 30 transactions in P12M ($M = 3.25$) (highlighted in orange in Table 10).
- **Availability (as in Herding)** (statements h, i and g):
 - For statement h and statement i, the respective means decrease from $M = 3.73$ (for those with 1–5 transactions in P12M) to $M = 3.54$ (for those with over 30 transactions), and from $M = 3.56$ (for those with 1–5 transactions in P12M) to $M = 3.29$ (for those with over 30 transactions) (highlighted in orange in Table 10).
 - For statement g, herding regarding types of virtual assets declines from those with 1–5 transactions in P12M ($M = 3.54$) to those with over 30 transactions in P12M ($M = 3.39$) (highlighted in orange in Table 10).
- **Anchoring (with possibilities of other biases)** (statement d): The mean declines from those with 0 transactions in P12M ($M = 5.00$) to those with 11–30 transactions in P12M ($M = 3.48$) (highlighted in orange in Table 10).
- **Representativeness** (and possibly **Availability as in Recency bias**) (statement j): Anchoring to recent experiences declines from those with 0 transactions in P12M ($M = 4.67$) to those with over 30 transactions in P12M ($M = 3.25$) (highlighted in orange in Table 10).

Therefore, it is reasonable to hypothesize that the level of engagement with virtual asset investment (e.g. frequency of trading) has a significant impact on the level of adherence to heuristic principles.

Table 10

Frequency of Trading Virtual Assets and Agreement with Statements

Statements			Key heuristics	None in P12 M (N = 6)	1–5 times (N = 166)	6–10 times (N = 196)	11–30 times (N = 105)	> 30 times (N = 28)	ANOVA
				Mean	Mean	Mean	Mean	Mean	F (4, 496)
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	4.33	4.04	4.01	4.01	4.07	0.39
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Overconfidence	4.00	3.10	3.28	3.40	4.00	10.02 **
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	4.00	3.12	3.06	3.07	3.36	2.05
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	5.00	3.84	3.63	3.48	3.57	7.78 **
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	2.33	3.17	2.80	2.44	2.39	17.85 **
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。	Overconfidence	1.17	3.13	3.34	3.42	3.57	16.06 **

Statements			Key heuristics	None in P12 M (N = 6)	1–5 times (N = 166)	6–10 times (N = 196)	11–30 times (N = 105)	> 30 times (N = 28)	ANOVA
				Mean	Mean	Mean	Mean	Mean	F (4, 496)
g)	Other investors' decisions on choosing virtual asset types have an impact on my investment decisions.	其他投資者選擇虛擬資產的 <u>類型</u> 會影響我的投資決定。	Availability	2.17	3.54	3.56	3.37	3.39	5.57 **
h)	Other investors' decisions on virtual assets volume have an impact on my investment decisions.	其他投資者投資虛擬資產的 <u>交易量</u> 會影響我的投資決定。	Availability	2.50	3.73	3.60	3.65	3.54	3.78 **
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	2.50	3.56	3.55	3.52	3.29	3.16 *
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representativeness	4.67	3.63	3.52	3.43	3.25	3.89 **
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	1.17	3.63	3.45	3.28	3.25	14.52 **
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	3.83	3.82	3.57	3.64	3.75	2.29

Statements			Key heuristics	None in P12 M (N = 6)	1–5 times (N = 166)	6–10 times (N = 196)	11–30 times (N = 105)	> 30 times (N = 28)	ANOVA
				Mean	Mean	Mean	Mean	Mean	F (4, 496)
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	3.67	3.66	3.54	3.55	3.50	0.69

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Proportion of Virtual Assets (in Liquid Assets) and Decision Heuristics

The proportion of virtual assets in investors' liquid assets (or its allocation in liquid asset portfolio) is a strong predictor of heuristics use in decision-making.

Investors with a higher proportion of virtual assets (in liquid assets) tend to associate with heuristics such as:

- **Mental accounting (as in House money effect)** (statement c): 5% or less (M = 2.72) increases to 51–80% (M = 3.75) (highlighted in green in Table 11).
- **Availability (as in Fear of missing out)** (statement l): 5% or less (M = 3.60) increases to 51–80% (M = 4.32) (highlighted in green in Table 11).
- **Anchoring (and other possible biases)** (statement m): 5% or less (M = 3.32) increases to 51–80% (M = 4.11) (highlighted in green in Table 11).
- **Anchoring (possibly with Gamblers' fallacy and Representativeness)** (statement a): 5% or less (M = 3.68) increases to 51–80% (M = 4.36) (highlighted in green in Table 11).
- **Representativeness (and possibly Availability as in Recency bias)** (statement j): 5% or less (M = 3.04) increases to 51–80% (M = 3.96) (highlighted in green in Table 11).

In contrast, investors with a lower proportion of virtual assets (in liquid assets) tend to associate with heuristics such as:

- **Overconfidence** (statement b): 5% or less (M = 3.52) decreases to 51–80% (M = 2.75) (highlighted in orange in Table 11).
- **Overconfidence** (statement f): 5% or less (M = 3.76) decreases to 51–80% (M = 3.21) (highlighted in orange in Table 11).

- **Availability (as in Herding)** (statement g): 5% or less (M = 3.64) decreases to 51–80% (M = 3.00) (highlighted in orange in Table 11).
- **Availability (as in Herding)** (statement i): 5% or less (M = 3.68) decreases to 51–80% (M = 3.18) (highlighted in orange in Table 11).
- **Mental accounting (as in Loss aversion)** (statement e): 5% or less (M = 3.20) decreases to 51–80% (M = 2.54) (highlighted in orange in Table 11).

The implication is that investors who have different virtual asset allocations or different balances in their investment portfolio can be subject to the effects of various heuristic rules.

Table 11

Proportion of Virtual Assets (in Liquid Assets) and Agreement with Statements

Statements			Key heuristics	≤ 5% (N = 25)	6–20% (N = 266)	21–50% (N = 182)	51–80% (N = 28)	ANOVA
				Mean	Mean	Mean	Mean	F (3, 497)
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	3.68	3.98	4.08	4.36	5.35 **
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Overconfidence	3.52	3.38	3.23	2.75	6.57 **
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	2.72	3.02	3.20	3.75	7.40 **
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	3.84	3.64	3.68	4.00	1.99
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	3.20	2.84	2.78	2.54	3.15 *

Statements			Key heuristics	≤ 5% (N = 25)	6–20% (N = 266)	21–50% (N = 182)	51–80% (N = 28)	ANOVA
				Mean	Mean	Mean	Mean	F (3, 497)
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出好的投資。	Overconfidence	3.76	3.20	3.32	3.21	4.28 **
g)	Other investors' decisions on choosing virtual asset <u>types</u> have an impact on my investment decisions.	其他投資者選擇虛擬資產的 <u>類型</u> 會影響我的投資決定。	Availability	3.64	3.53	3.47	3.00	4.23 **
h)	Other investors' decisions on virtual assets <u>volume</u> have an impact on my investment decisions.	其他投資者投資虛擬資產的 <u>交易量</u> 會影響我的投資決定。	Availability	3.76	3.66	3.62	3.39	1.12
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	3.68	3.58	3.47	3.18	2.67 *
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representative-ness	3.04	3.55	3.52	3.96	4.59 **
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	3.48	3.41	3.45	3.57	0.33
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	3.60	3.61	3.70	4.32	6.92 **
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	3.32	3.58	3.54	4.11	5.82 **

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Risk Perception of Different Types of Virtual Assets and Decision Heuristics

Correlation analysis is carried out to examine the association between the different items and the aggregated level of perceived risk in the four virtual asset products (cryptocurrencies, non-fungible tokens, stablecoins and security tokens). With three levels (high, medium and low) for each of the products, the range of aggregated scores for risk perception is between 4 and 12. Among those who are aware of all products (N = 479), the mean for this aggregated risk perception is 10.2 and SD is 1.71.

As can be seen in the following table, weak negative correlations exist between perceived risk and these heuristic rules:

- **Anchoring (and other possible biases)** (statement d): $r = -.24$
- **Representativeness** (and possibly **Availability as in Recency bias**) (statement j): $r = -.129$
- **Overconfidence** (statement b): $r = -.11$

A weak positive correlation exists between perceived risk with:

- **Availability (as in Herding)** (statement g): $r = .11$

The higher the level of perceived risk, the more the investors subscribe to **Herding**, but move away from **Anchoring**, **Representativeness** (and possibly **Availability in terms of Recency bias**) and **Overconfidence**.

Table 12

Correlations between Aggregated Risk Perception of Virtual Asset Products and Agreement with Statements

Statements			Key heuristics	Pearson correlation	Sig. (2-tailed)
a)	I rely on my previous experiences in the market for my next investment.	我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring	-0.08	
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market.	我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Overconfidence	-.11	*
c)	After a prior gain, I am more risk-seeking than usual.	在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting	0.08	

Statements			Key heuristics	Pearson correlation	Sig. (2-tailed)
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value.	我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring	-.24	**
e)	After a prior loss, I become more risk-averse.	在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting	-0.06	
f)	My instinct has often helped me make good investments.	我的直覺經常幫助我做出的投資。	Overconfidence	0.09	
g)	Other investors' decisions on choosing virtual asset types have an impact on my investment decisions.	其他投資者選擇虛擬資產的 類型 會影響我的投資決定。	Availability	.11	*
h)	Other investors' decisions on virtual assets volume have an impact on my investment decisions.	其他投資者投資虛擬資產的 交易 量 會影響我的投資決定。	Availability	0.07	
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions.	其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	0.00	
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities.	在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representative-ness	-.13	**
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do.	在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability	0.02	
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit.	當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability	-0.01	
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets.	當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring	0.06	

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

7.2 Factorial-Level Analysis

Using SPSS, a factor analysis with varimax rotation generates the following five factors indicating different types of heuristic strategies used in virtual asset investment.

Table 13

Rotated Component Matrix showing the key Factors Underlying the Items

Items		Key heuristics	Component				
			1	2	3	4	5
i)	Other investors' decisions on buying and selling virtual assets have an impact on my investment decisions. 其他投資者買入或賣出虛擬資產的選擇會影響我的投資決定。	Availability	0.878				
h)	Other investors' decisions on virtual assets volume have an impact on my investment decisions. 其他投資者投資虛擬資產的 交易量 會影響我的投資決定。	Availability	0.836				
g)	Other investors' decisions on choosing virtual asset types have an impact on my investment decisions. 其他投資者選擇虛擬資產的 類型 會影響我的投資決定。	Availability	0.824				
e)	After a prior loss, I become more risk-averse. 在先前的投資虧損之後，我變得更不願承擔風險。	Mental accounting		0.688			
k)	When it comes to investing in/trading virtual assets, I rely on authority figures telling me what to do. 在投資/買賣虛擬資產上，我會依靠權威人士來告訴我該怎麼做。	Availability		0.677			0.331
b)	I believe that my skills and knowledge of the virtual assets market can help me to outperform the market. 我相信我對虛擬資產市場的技能 and 知識可以幫助我跑贏大市。	Over-confidence		-0.606			0.438

Items		Key heuristics	Component				
			1	2	3	4	5
j)	I give more weight to recent experiences over long-term averages when analysing prospects and their probabilities. 在分析市場前景及其機遇時，我會優先考慮近期的經驗而不是資產長遠的平均價值。	Representative-ness			0.763		
c)	After a prior gain, I am more risk-seeking than usual. 在先前的投資獲利之後，我會比平時追求更高風險的投資。	Mental accounting			0.606		
a)	I rely on my previous experiences in the market for my next investment. 我依靠我在市場上的過往經驗來進行下一次投資。	Anchoring			0.551		0.369
m)	When prices continue to fall, I think that there will be a price reversal, so I hold on to virtual assets. 當價格持續下跌時，我會認為價格會回升，因此我會繼續持有虛擬資產。	Anchoring				0.815	
d)	I avoid selling virtual assets that have decreased in value and readily sell virtual assets that have increased in value. 我避免出售價值下降的虛擬資產，並傾向出售已升值的虛擬資產。	Anchoring				0.655	
f)	My instinct has often helped me make good investments. 我的直覺經常幫助我做出好的投資。	Over-confidence					0.850
l)	When I see virtual asset prices keep rising, I am afraid of missing out on opportunities for profit. 當我看到虛擬資產價格不斷上升時，我會害怕錯過獲利機會。	Availability		0.339	0.331	0.340	

Table 14

Correlation Matrix between Individual Items

	Items												
	a	b	c	d	e	f	g	h	i	j	k	l	m
a	-												
b	.037	-											
c	.209**	.200**	-										
d	.105**	-.020	.108**	-									

e	-.013	-.219**	-.086*	.024	-								
f	.149**	.326**	.070	-.092*	-.043	-							
g	-.117**	-.022	-.081*	-.122**	.137**	.178**	-						
h	-.067	-.018	-.053	-.109**	.135**	.176**	.605**	-					
i	-.153**	.074*	-.091*	-.006	.052	.130**	.604**	.610**	-				
j	.220**	.021	.229**	.126**	.060	-.096*	-.045	.000	-.027	-			
k	-.036	-.190**	-.104**	-.038	.243**	.148**	.212**	.209**	.149**	-.025	-		
l	.154**	-.146**	.068	.175**	.087*	-.093*	-.037	.068	.058	.109**	.119**	-	
m	.167**	-.075*	.136**	.262**	-.123**	-.004	-.062	-.093*	-.065	.015	.080*	.078*	-

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Table 15

Total Variance Explained by the 5 Factors

Component	Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %
1	2.28	17.6	17.6
2	1.54	11.8	29.4
3	1.50	11.5	40.9
4	1.38	10.6	51.5
5	1.35	10.4	61.9

Heuristic Strategies on Virtual Asset Investment

The five factors can be interpreted as distinctive heuristic strategies used by different virtual asset investors:

- **Strategy 1 – Herding** (investors make decisions based on other investors' decisions)
- **Strategy 2 – Secure Obedience** (investors make decisions based on authority figures rather than their own skills and knowledge, possibly due to lower risk tolerance after prior losses)
- **Strategy 3 – Distrustful Empiricism** (investors rely on their own personal experience, both previous and recent, rather than long-term objective data)
- **Strategy 4 – Wishful Speculation** (investors tend to speculate by holding onto assets with decreased value)
- **Strategy 5 – Intuitive Confidence** (investors tend to believe strongly in their personal insights and intuition)

7.2.1 DEMOGRAPHIC VARIABLES

Heuristic Strategies and Gender

Males tend to be associated with the heuristic strategies of ***Intuitive Confidence*** and ***Distrustful Empiricism*** (highlighted in orange in Table 16), whereas females tend to adhere to ***Secure Obedience*** and ***Herding*** (highlighted in green in Table 16).

Table 16

Heuristic Strategies and Gender

Heuristic strategies		Male (N = 359)		Female (N = 142)		ANOVA	
		Mean	SD	Mean	SD	F (1, 499)	
Strategy 1	Herding	3.49	0.71	3.68	0.63	7.51	**
Strategy 2	Secure obedience	3.26	0.44	3.40	0.37	11.49	**
Strategy 3	Distrustful empiricism	3.59	0.59	3.46	0.58	5.32	*
Strategy 4	Wishful speculation	3.62	0.63	3.65	0.63	0.15	
Strategy 5	Intuitive confidence	3.27	0.39	3.15	0.40	10.57	**

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Heuristic Strategies and Age

Using the original five age brackets (as used in the questionnaire) in the analysis, it is revealed that there is a lower tendency to adopt ***Distrustful empiricism*** with increasing age (highlighted in orange in Table 18).

Table 17

Heuristic Strategies and Age (3 age groups)

Heuristic strategies	18–29 (N = 169)	30–39 (N = 215)	40–69 (N = 117)	ANOVA
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		Mean	Mean	Mean	F (2, 498)
Strategy 1	Herding	3.62	3.51	3.52	1.26
Strategy 2	Secure obedience	3.35	3.26	3.28	2.07
Strategy 3	Distrustful empiricism	3.62	3.55	3.48	1.95
Strategy 4	Wishful speculation	3.70	3.58	3.62	1.75
Strategy 5	Intuitive confidence	3.25	3.23	3.22	0.20

Table 18

Heuristic Strategies and Age (5 age groups)

Heuristic strategies		18–29 (N = 169)	30–39 (N = 215)	40–49 (N = 69)	50–59 (N = 46)	60–69 (N = 2)	ANOVA
		Mean	Mean	Mean	Mean	Mean	F (2, 498)
Strategy 1	Herding	3.62	3.51	3.51	3.53	3.67	0.66
Strategy 2	Secure obedience	3.35	3.26	3.25	3.32	3.06	1.35
Strategy 3	Distrustful empiricism	3.62	3.55	3.56	3.39	2.67	2.50 *
Strategy 4	Wishful speculation	3.70	3.58	3.65	3.58	3.50	0.99
Strategy 5	Intuitive confidence	3.25	3.23	3.23	3.21	3.10	0.17

* significant $p \leq 0.05$

Heuristic Strategies and Education

Investors with a lower education level display a higher tendency to ***Distrustful empiricism*** (highlighted in orange in Table 19).

Table 19

Heuristic Strategies and Education

Heuristic strategies		Junior secondary (N = 1)	Senior secondary (N = 106)	College/ asso. deg. (N = 187)	Bachelor (N = 180)	Master or above (N = 27)	ANOVA
		Mean	Mean	Mean	Mean	Mean	F (4, 496)
Strategy 1	Herding	2.00	3.53	3.53	3.55	3.77	1.98
Strategy 2	Secure obedience	2.50	3.34	3.31	3.25	3.38	2.15
Strategy 3	Distrustful empiricism	3.33	3.67	3.59	3.46	3.54	2.41 *
Strategy 4	Wishful speculation	3.50	3.68	3.64	3.65	3.26	2.64 *
Strategy 5	Intuitive confidence	3.20	3.27	3.21	3.26	3.19	0.67

* significant $p \leq 0.05$

Heuristic Strategies and Personal Income

Investors with a lower monthly personal income tend to adhere to **Secure obedience** to a larger extent (highlighted in orange in Table 20).

Table 20

Heuristic Strategies and Personal Income

Heuristic strategies		< HK\$1 5k (N = 1)	HK\$15 k– \$19k (N = 77)	HK\$20 k– \$29k (N = 208)	HK\$30 k– \$49k (N = 135)	HK\$50 k– \$69k (N = 55)	HK\$70 k– \$99k (N = 6)	ANOVA
		Mean	Mean	Mean	Mean	Mean	Mean	F (5, 476)
Strategy 1	Herding	4.00	3.58	3.61	3.44	3.54	3.28	1.30
Strategy 2	Secure obedience	3.25	3.38	3.34	3.18	3.26	2.94	4.11 **
Strategy 3	Distrustful empiricism	4.00	3.68	3.54	3.59	3.45	3.50	1.36
Strategy 4	Wishful speculation	3.50	3.71	3.66	3.60	3.49	3.42	1.09
Strategy 5	Intuitive confidence	2.60	3.27	3.23	3.26	3.23	3.37	0.83

** extremely significant $p \leq 0.01$

7.2.2 WEALTH AND INVESTMENT RELATED VARIABLES

Heuristic Strategies and Liquid Assets

Investors with lower liquid assets have a higher tendency to adopt **Herding** and **Secure obedience** (highlighted in orange in Table 21).

Table 21

Heuristic Strategies and Liquid Assets

Heuristic strategies		< HK\$5 0k (N = 15)	HK\$5 0k– 99k (N = 38)	HK\$1 00k– 199k (N = 85)	HK\$2 00k– 499k (N = 144)	HK\$5 00k– 999k (N = 121)	HK\$1 m– 2.9m (N = 84)	HK\$3 m– 4.9m (N = 13)	≥ HK\$5 m (N = 1)	ANOVA
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	F (7, 493)
Strategy 1	Herding	3.44	3.32	3.75	3.59	3.58	3.34	3.46	4.33	3.18 **
Strategy 2	Secure obedience	3.38	3.28	3.43	3.31	3.27	3.17	3.20	3.13	2.64 *
Strategy 3	Distrustful empiricism	3.56	3.54	3.49	3.54	3.69	3.50	3.44	3.00	1.35
Strategy 4	Wishful speculation	3.83	3.99	3.55	3.61	3.60	3.57	3.73	4.00	2.49 *
Strategy 5	Intuitive confidence	3.31	3.15	3.20	3.25	3.28	3.18	3.32	3.80	1.25

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Heuristic Strategies and Experience in Virtual Assets Investment

The more experienced virtual asset investors become, the less likely they are to adhere to **Secure obedience** (highlighted in orange in Table 22).

Table 22

Heuristic Strategies and Experience in Virtual Assets

Heuristic strategies		< 1 year (N = 30)	1–3 years (N = 248)	4–5 years (N = 175)	6–10 years (N = 41)	> 10 years (N = 7)	ANOVA
		Mean	Mean	Mean	Mean	Mean	F (4, 496)
Strategy 1	Herding	3.61	3.58	3.54	3.33	3.57	1.29
Strategy 2	Secure obedience	3.45	3.33	3.25	3.16	3.18	3.15 *
Strategy 3	Distrustful empiricism	3.68	3.60	3.51	3.43	3.14	2.34
Strategy 4	Wishful speculation	3.60	3.62	3.65	3.66	3.71	0.12
Strategy 5	Intuitive confidence	3.37	3.24	3.21	3.19	3.26	1.22

* significant $p \leq 0.05$

Heuristic Strategies and Trading Frequency of Virtual Assets

Investors who trade virtual assets more frequently (in other words, those with higher engagement) appear to alienate themselves from the heuristic strategies of **Secure obedience**, **Herding**, **Wishful speculation** and **Distrustful empiricism** (highlighted in orange in Table 23). In other words, investors with lower engagement (they could be beginners or passive) are more susceptible to various heuristic strategies instead.

Table 23

Heuristic Strategies and Trading Frequency in Virtual Assets

Heuristic strategies		None in P12M (N = 6)	1–5 times (N = 166)	6–10 times (N = 196)	11–30 times (N = 105)	> 30 times (N = 28)	ANOVA
		Mean	Mean	Mean	Mean	Mean	F (4, 496)
Strategy 1	Herding	2.39	3.61	3.57	3.51	3.40	5.10 **
Strategy 2	Secure obedience	2.31	3.41	3.30	3.21	3.08	15.56 **
Strategy 3	Distrustful empiricism	4.33	3.60	3.53	3.50	3.56	3.21 *
Strategy 4	Wishful speculation	4.33	3.75	3.58	3.51	3.54	4.84 **
Strategy 5	Intuitive confidence	3.30	3.27	3.22	3.16	3.38	2.38

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Heuristic Strategies and Proportion of Virtual Assets Investment in Liquid Assets

Investors with a higher proportion of virtual assets (in liquid assets) tend to associate with increased use of heuristic strategies such as ***Distrustful empiricism*** and ***Wishful speculation*** (highlighted in green in Table 24), but decreased use of ***Herdning*** (highlighted in orange in Table 24).

Table 24

Heuristic Strategies and Virtual Assets Investment in Liquid Assets

Heuristic strategies		≤ 5% (N = 25)	6–20% (N = 266)	21–50% (N = 182)	51–80% (N = 28)	ANOVA
		Mean	Mean	Mean	Mean	F (3, 497)
Strategy 1	Herdning	3.69	3.59	3.52	3.19	3.31 *
Strategy 2	Secure obedience	3.38	3.29	3.30	3.26	0.44
Strategy 3	Distrustful empiricism	3.15	3.52	3.60	4.02	11.36 **
Strategy 4	Wishful speculation	3.58	3.61	3.61	4.05	4.58 **
Strategy 5	Intuitive confidence	3.41	3.21	3.24	3.25	1.87

* significant $p \leq 0.05$

** extremely significant $p \leq 0.01$

Correlations between Heuristic Strategies and Risk Perception of Virtual Asset Products

Correlation analysis is carried out to examine the association between the heuristic strategies and the aggregated level of perceived risk in the four virtual asset products (cryptocurrencies, non-fungible tokens, stablecoins and security tokens).

As can be seen in the following table, weak negative correlations exist between perceived risk and these heuristic strategies. The higher the perceived risk, the less these strategies are used:

- **Wishful speculation:** $r = -.12$
- **Intuitive confidence:** $r = -.10$

Table 25

Correlation between Heuristic Strategies and Aggregated Perceived Risk of Virtual Asset Products

Heuristic strategies		Pearson correlation
Strategy 1	Herding	0.07
Strategy 2	Secure obedience	0.06
Strategy 3	Distrustful empiricism	-0.05
Strategy 4	Wishful speculation	-.12**
Strategy 5	Intuitive confidence	-.10*

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

8. CONCLUSIONS AND RECOMMENDATIONS

- Individual investors employ heuristic strategies (also known as mental shortcuts or rules of thumb) to reduce the complexities in their decision-making. In many cases, these heuristics may lead to various cognitive biases in the decision-making process of investors.
- Virtual assets, like other investment tools, may have their own characteristics and market-specific factors. Given the overwhelming optimistic sentiments of most virtual asset investors, the selected heuristics may be particularly powerful in the virtual assets market.
- Investors cannot completely avoid using heuristics. Not all types of investors adopt the same heuristics.
- Here are some recommendations on how to tackle biases caused by heuristics:
 - Investors should be aware of such psychological biases and fallacies, and seek to avoid them to lower the risk of making illogical investment decisions and to take advantage of this information in order to improve their returns;
 - Investors should monitor their investment behaviour and strive to keep their own behavioural biases in check;
 - Investors should make investment decisions based on a balance of both personal information and publicly available information;
 - More fundamental/proper research should be conducted into the intrinsic value of a project or virtual asset with due diligence;
 - Investors should make unbiased decisions based on different types of data on market realities and fundamental valuation over a longer period of time;
 - Investors should consider diversifying investment/portfolios to reduce overall risk;
 - Investors should distinguish between short-term and sufficiently long-term horizons with compounding;
 - Investors should distinguish between objective facts and subjective emotions, maintain calm and make rational decisions;
 - Investors should use intuitive decision-making processes (fast thinking) or more careful decision-making processes (slow thinking) appropriately;
 - Investors should prioritise financial literacy to improve investment knowledge and skills in making investment decisions and minimise overreliance on heuristics, which often leads to biases.

Appendix: A Glossary of Heuristic Terms

Heuristic	Meaning
Availability	People make decisions and judgements based on the ease with which information and thoughts can be brought to mind. Things that are easy to recall (based on familiarity, vividness or recency) enjoy more salience and influence our decision-making more strongly. As an example, investors may only refer to readily available information and not consider other alternatives in making investment decisions.
Anchoring	People make decisions based on the initial reference point or the very first set of information they get. This has a priming effect, whereby initial exposure to an anchor serves as a false reference point and influences subsequent judgements about value. As an example, future prices of a cryptocurrency are talked about in relation to its price at initial coin offering (an anchor).
Representativeness	People consider as likely an event that is more representative and similar to an existing mental prototype, or make decisions based on past events or traits that are representative of or similar to the current situation. For example, the probability that a new cryptocurrency will produce returns is judged basing on whether it resembles previous lucrative cryptocurrencies.
Overconfidence	People can overestimate their ability, knowledge and skills and believe that they are able to earn a higher return. This can take the form of the illusion of control, illusion of knowledge, self-attribution bias or overoptimism. Investors who are too sure of their investment ability may make risky investment decisions.
Mental accounting	This is the tendency to separate one's money into different mental accounts based on subjective criteria such as source or commitment, and to assign different mental values to the same sum of money. As an example, investors tend to invest using mental compartmentalisation, and consider their assets separately, failing to see interactions between different asset classes.

Heuristic	Meaning
Gamblers' fallacy	The belief that a certain random event is more or less likely to occur given a previous event or series of events, or that correction will occur in a fair gamble. An example with virtual assets would be someone believing that he/she is bound to make a profitable trade since he/she has lost money on the past 15 trades.
Loss aversion	The pain of losing (regret) is more powerful than the pleasure of gaining (pride). An investor's reluctance to suffer losses means that he/she is more willing to make decisions to avoid a loss than to make a gain. The key rule is 'Don't lose money'. As an example, losing \$100,000 triggers more intense emotions than gaining \$100,000.
Sunk-cost fallacy	With a general unwillingness to accept failure, people tend to invest more money trying to make an investment work. This relates to an emotional tendency to invest more and more money, time and effort into an existing investment. It is closely linked to loss aversion.
Disposition effect	The tendency to hold on to losing investments too long, while selling winning assets too soon. It is closely linked to loss aversion and mental accounting.
Prospect theory	People make decisions based on relative gains and losses instead of in absolute terms. The theory covers several heuristics used subconsciously by people as they make financial evaluations: loss aversion, disposition effect and mental accounting.
Fear of missing out	This refers to the anxiety associated with not having the same experiences or achievements as peers. In investment terms, investors are afraid of missing out on potential opportunities by not investing in the market.

Heuristic	Meaning
Herding (social proof)	Decision-making based on the investment decisions of leaders or other investors in the market. Investors who exhibit herding tend to trust the investment decisions of other parties and also the collective information circulating in the public, causing them to ignore their own beliefs and imitate the actions of other investors.
Confirmation bias	People actively search for information that matches with their existing point of view or beliefs. At the same time, information that contradicts these beliefs is discounted or rejected.
Optimism	The tendency to overestimate the possibility that positive things will happen and underestimate the potential for unpleasant events. In other words, it is the belief that one is less likely to suffer a negative event and more likely to experience a positive event than other people.
Recency bias	People tend to give more weight to an event that has happened recently. Investors tend to place more emphasis on recent events in the investment markets. Closely linked to availability.
Authorities	Decision-making based on expert opinions and recommendations from investment consultants.
House money effect	Investors tend to take on greater risk when reinvesting profit earned through investing than they would when investing their savings or wages.