科技部補助專題研究計畫報告

人工智能與同步效應對面試官和應徵者在不同視訊面試媒介之反應研究(第2年)

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本研究具有政策應用參考價值：□否　■是，建議提供機關勞動部,行政院人事行政總處
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中　華　民　國　109　年　09　月　15　日

中 文 摘 要 ： 有愈來愈多產業界，將非同步視頻面試結合人工智慧面試代理人應用在人力甄選的流程中。相較於傳統同步視頻面試，大大提升人力篩選的效率。然而，對於面試官與應徵者是否因非同步視頻面試或人工智慧面試代理人的使用，是否產生不同的行為反應，至今仍缺乏學術性的驗證。本研究以媒體豐富性理論和社交介面理論為基礎，透過實驗設計的方式，分別比較視頻面試的同步效應是否會影響面試官的評分標準，同時比較應徵者對於同步效應與人工智慧面試代理人的感受與公平知覺。本計畫第一年研究初步發現，無論使用同步或非同步視頻面試，面試官對應徵者的評分，仍存在第一印象與外貌的偏誤。但非同步視頻面試可以削弱該先入為主的偏誤對面試官評分的影響力。對於應徵者而言，相較於跟機器對話的同步視頻面試，會覺得與真人對話的同步視頻面試較自在。至於公平性的知覺則不會因為同步效應或使用人工智慧代理人而有所差異。換言之，採用非同步視頻面試可以顯著降低面試官對應徵者先入為主的第一印象對評分的影響，間接提升甄選的信/效度與公平性。基於非同步視頻面試的便利性與成本效益，可作為產業界進行初步人力篩選的應用。目前廣受大眾媒體質疑，應徵者是否對雇主使用非同步視頻面試軟體或人工智慧面試代理人的公平性疑慮，相較於使用真人面試官與同步視頻面試軟體，本研究並未發現有顯著的差異。

中 文 關 鍵 詞 ： 人工智慧，非同步視頻面試，同步視頻面試，媒體豐富性理論，社交介面理論，先入為主的效應

英 文 摘 要 ： The use of asynchronous video interviews (AVIs) and artificial intelligence (AI)-based decision agents enables more efficient employment screening compared with traditional synchronous video interviews (SVIs). However, the social impacts of using synchrony and AI decision agents in video interviews have not been investigated. Drawing on media richness theory and social interface theory, this study employed a novel experimental design to compare human ratings and job applicants' response behaviours between the SVI and AVI settings and compare job applicants' fairness perception between the AVI setting and the AVI setting using an AI decision agent (AVI-AI). The results from 180 observations revealed that 1) first impression and physical appearance significantly affected structured interview ratings regardless of whether the video interview was synchronous; 2) compared with SVIs, AVIs lessened the primacy effect on physical appearance and initial impression among human raters; 3) job applicants had indistinguishable fairness perceptions regarding synchrony (SVI vs. AVI) and decision agent (human vs. AI); and 4) applicants exhibited less favourability towards AVIs than towards SVIs. Findings from this experimental comparison, including recommendations for practice and future research on human resource selection, technology education, and social computing, are discussed.

科技部補助專題研究計畫成果報告

（□期中進度報告/■期末報告）

（計畫名稱）

計畫類別：■個別型計畫　　□整合型計畫
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執行機構及系所：臺灣師範大學科技應用與人力資源發展學系

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中　　華　　民　　國 109 年 09 月 15 日

人工智能與同步效應對面試官和應徵者在不同視訊面試媒介之反應研究

摘要

　　有愈來愈多產業界，將非同步視頻面試結合人工智慧面試代理人應用在人力甄選的流程中。相較於傳統同步視頻面試，大大提升人力篩選的效率。然而，對於面試官與應徵者是否因非同步視頻面試或人工智慧面試代理人的使用，是否產生不同的行為反應，至今仍缺乏學術性的驗證。本研究以媒體豐富性理論和社交介面理論為基礎，透過實驗設計的方式，分別比較視頻面試的同步效應是否會影響面試官的評分標準，同時比較應徵者對於同步效應與人工智慧面試代理人的感受與公平知覺。本計畫第一年研究初步發現，無論使用同步或非同步視頻面試，面試官對應徵者的評分，仍存在第一印象與外貌的偏誤。但非同步視頻面試可以削弱該先入為主的偏誤對面試官評分的影響力。對於應徵者而言，相較於跟機器對話的同步視頻面試，會覺得與真人對話的同步視頻面試較自在。至於公平性的知覺則不會因為同步效應或使用人工智慧代理人而有所差異。換言之，採用非同步視頻面試可以顯著降低面試官對應徵者先入為主的第一印象對評分的影響，間接提升甄選的信/效度與公平性。基於非同步視頻面試的便利性與成本效益，可作為產業界進行初步人力篩選的應用。目前廣受大眾媒體質疑，應徵者是否對雇主使用非同步視頻面試軟體或人工智慧面試代理人的公平性疑慮，相較於使用真人面試官與同步視頻面試軟體，本研究並未發現有顯著的差異。

Abstract

　　The use of asynchronous video interviews (AVIs) and artificial intelligence (AI)-based decision agents enables more efficient employment screening compared with traditional synchronous video interviews (SVIs). However, the social impacts of using synchrony and AI decision agents in video interviews have not been investigated. Drawing on media richness theory and social interface theory, this study employed a novel experimental design to compare human ratings and job applicants' response behaviours between the SVI and AVI settings and compare job applicants' fairness perception between the AVI setting and the AVI setting using an AI decision agent (AVI-AI). The results from 180 observations revealed that 1) first impression and physical appearance significantly affected structured interview ratings regardless of whether the video interview was synchronous; 2) compared with SVIs, AVIs lessened the primacy effect on physical appearance and initial impression among human raters; 3) job applicants had indistinguishable fairness perceptions regarding synchrony (SVI vs. AVI) and decision agent (human vs. AI); and 4) applicants exhibited less favourability towards AVIs than towards SVIs. Findings from this experimental comparison, including recommendations for practice and future research on human resource selection, technology education, and social computing, are discussed.

關鍵字　人工智慧，非同步視頻面試，同步視頻面試，媒體豐富性理論，社交介面理論，先入為主的效應

Keywords: Artificial intelligence (AI), asynchronous video interview (AVI), synchronous video interview (SVI), media richness theory, social interface theory, impressional primacy effect

1 Introduction

The use of asynchronous video interviews (AVIs) and artificial intelligence (AI)-based decision agents are

recent innovations in the personnel selection process (Mejia & Torres, 2018). AVIs allow pre-hire interviewing to occur any time and anywhere in the world, and employers can use AVIs to interview an unlimited number of job candidates and record their answers automatically (see Brenner, Ortner, & Fay, 2016). In addition, AVIs enable employers or recruiters to fast-screen or skip certain candidates (Torres & Gregory, 2018). With regard to AI-based decision agents (Ötting & Maier, 2018), predictive models can be built to short-list candidates when human evaluators of video interviews are in demand (see Rasipuram, Rao, & Jayagopi, 2016).

While both AVIs and AI-based decision agents have attracted increasing attention and are used in employment screening (Rao, Rasipuram, Das, & Jayagopi, 2017), AI video interview solutions represent a promising alternative that combines the advantages of both (e.g., HireVue, 2018). AI involves "intelligent systems that act and reason as humans in a specific domain" (Martínez-Miranda & Aldea, 2005). AI video interviews integrate the functions of both AVIs and AI and use a combination of visual and audio recognition techniques in tandem with machine learning to determine which applicants most resemble the ideal candidate (see Celiktutan & Gunes, 2017). In addition to screening multiple applicants at once, AI video interview software can match the right candidates with the right positions by auto-assessing the candidates' verbal and nonverbal cues based on social information processing (Walther, 2011).

In contrast to "two-way" synchronous video interviews (SVIs) (see Toldi, 2011), such as Skype (2018), AVIs with or without an AI decision agent are known as "one-way" interviews, in which job applicants' answers are recorded at one point in time and can be evaluated at another point in time (Mejia & Torres, 2018). To increase the availability of personnel resources, this cutting-edge technology has emerged and begun to displace traditional long-distance telephone interviews and conference interviews (Torres & Mejia, 2017). However, the use of different video interview modalities (synchronous vs. asynchronous) and different decision agents (human vs. AI) may elicit different responses from both interviewers and job applicants (see Haan, Ongena, Vannieuwenhuyze, & De Glopper, 2017; Ötting & Maier, 2018); Straus, Miles, and Laurie (2001) referred to these as unintended social impacts.

As with a variety of technology applications in employment interviews, there is a gap between the use of different video interviews for job candidate screening and research on the effects of these technologies (Naim, Tanveer, Gildea, & Hoque, 2018). Although they may include the same interview questions, different interview modes lead to different reactions (Zhang, Kuchinke, Woud, Velten, & Margraf, 2017). Langer, König, and Krause (2017) examined applicant reactions and interviewer ratings for both AVIs and SVIs and suggested that future studies should investigate how applicant reactions to and interviewer ratings of human-rated interviews and automatically rated interviews differ.

The present study investigated the synchrony effect by comparing human interviewer ratings and applicants' attitudes between the AVI and SVI settings. This study also investigated the AI decision agent effect by comparing applicants' responses between the AVI and AVI-AI settings. One focus of our study was how synchrony affects human ratings of applicants' interview performance in structured interviewing. Past research has found that initial impressions and applicants' physical appearance affect interviewer ratings regardless of interview structure and mode (see Nestler & Back, 2013; Torres & Gregory, 2018). However, these studies were based solely on either video recordings or face-to-face interviews. To the best of our knowledge, no study has attempted to compare the effect of initial impression and physical appearance on interview ratings between the SVI and AVI settings. Furthermore, this study examined applicant reactions to different video interview modalities and decision agents because applicant perceptions influence not only

applicants' perceived organizational attractiveness but also their intentions to accept the job, recommend the organization to others, or withdraw from the selection process (Guchait, Ruetzler, Taylor, & Toldi, 2014).

2 Background and hypotheses

2.1 The synchrony effect on interview ratings

According to social information processing theory (Walther, 2011), in a computer-mediated environment (such as video interviews), a stranger (such as an interviewer or rater) observes and interprets the explicit or implicit cues exhibited by others and makes inferences regarding their characteristics in a span of a few minutes. The cues or attributes, such as physical appearance, are commonly used by interviewers to make inferences about an interviewee with whom they have no acquaintance (Nestler & Back, 2013). Interviewers also utilize cues to form an initial impression and consider it along with physical appearance to determine their interview ratings (DeGroot & Motowidlo, 1999; Swider, Barrick, & Harris, 2016); however, most initial impressions do not predict job performance (Eisenkraft, 2013).

According to the lens model (Brunswik, 1956), when an observer has a more positive perception of a target's observable cues (e.g., appearance or initial impression), the observer will render a more positive judgement (e.g., interview rating) of the target in a consistent manner during an actual interaction or when viewing video clips (Nestler & Back, 2013). Empirical studies have also shown that initial impressions and physical appearance influence interviewer ratings more strongly than professional factors in any interview media and structural format (Swider et al., 2016; Torres & Gregory, 2018). Therefore, we argue that the synchrony effect (SVI vs. AVI) will not influence the interviewer's judgement regarding the relationship between an applicant's initial impression / appearance and his or her qualifications in video interviews. Thus, we propose the following two hypotheses:

> H1: An interviewer's initial impressions of an applicant will be positively correlated with interview rating regardless of whether the video interview is synchronous.
>
> H2: An applicant's physical appearance will be positively correlated with interview rating regardless of whether the video interview is synchronous.

Straus et al. (2001) found that different types of job interview modalities influence interviewers' evaluations differently. According to Daft and Lengel's (1986) media richness theory, types of media differ from one another in terms of "information richness". A medium is said to possess high information richness if it has a broad range of criteria. There are four criteria that contribute to information richness (Apers & Derous, 2017): (a) the capacity for immediate feedback between the sender and receiver in an interview process; (b) the number of cues and signals that can be transmitted through the medium; (c) the level of personalization, which is the ability to convey a sense of personal focus; and (d) language variety regarding whether the medium allows for the use of simple language versus complex language.

When we applied media richness theory in the context of this study, we found that SVIs exhibited more information richness than AVIs for the following reasons: (a) Asynchronous interviews offer low capacity for immediate feedback, as they involve one-way asynchronous interactions rather than two-way synchronous interactions (see Torres & Mejia, 2017). (b) In the synchronous setting, an interviewee can interact with an interviewer, and there are more opportunities to observe both verbal and nonverbal cues provided by the interviewee (see Langer et al., 2017). (c) Compared with AVI settings, in SVI settings,

interviewers have more opportunities to utilize different personal communication styles tailored to different interviewees (see Janghorban, Roudsari, & Taghipour, 2014), although employers can customize the look and information for targets in AVI settings. (d) Both interviewers and interviewees are better able to understand and decipher ambiguous or complex messages in SVI settings than in AVI settings (see Hassell & Cotton, 2017). Based on the above, compared to AVI, SVI leads to more personal interaction, which may lead to a greater media richness effect.

Chapman and Webster (2001) found that scoring of job applicants is determined by the information richness of the interview modality because information richness affects how human interviewers judge an interviewee's attributes and their post-interview impression by controlling initial impression. However, the greater the richness of information in the interview modality is, the greater the number of non-valid cues that are compatible with the interviewers' initial evaluation, such as physical appearance and initial impression, will be used by interviewers to form selection decisions during the interview. This phenomenon is called the impressional primacy effect (see Florea, Valcea, Hamdani, & Dougherty, 2019; Springbett, 1958). That is, people opt for evaluations that confirm their existing beliefs (Lord, Ross, & Lepper, 1979). In other words, information from the initial evaluation will be weighted more heavily in the interview rating in SVIs than in AVIs. In accordance with media richness theory and the impressional primacy effect, we argue that synchrony affects the relationships between applicant physical appearance and both initial impression and interview rating. Accordingly, the third and fourth hypotheses are proposed:

H3: Synchrony moderates the influence of applicants' initial impression on interview score.

H4: Synchrony moderates the influence of applicants' appearance rating on interview score.

2.2 Synchrony effect on applicant reactions

According to Long's (2001) social interface theory, when the computer interface is more akin to a human, it can facilitate human–computer interaction as well as human–human interaction. Therefore, respondents tend to treat computer interfaces like social actors in video-enhanced surveys (Gerich, 2012), and user responses become more similar to socially desirable responses compared to face-to-face interviews (Haan et al., 2017). According to media richness theory, although employment selection procedures requiring face-to-face interaction are more difficult to replace through technology (Stone, Deadrick, Lukaszewski, & Johnson, 2015), given sufficient interaction between interviewees and interviewers, video interviews can achieve a similar level of intimacy to that of face-to-face interviews (Shin, Liu, Jang, & Bente, 2017). In the context of video interviewing, synchrony influences applicants' reactions to the interviewers and the interview process (McCarthy et al., 2017). Applicants are more likely to evaluate the selection tool as favourable; that is, they will have a positive attitude after using the tools when they experience humanization during the selection process (Guchait et al., 2014). Therefore, applicants are more likely to perceive the interview as less favourable in AVI settings than in SVI settings because they interact with a real person behind the screen in an SVI, while they interact with a machine in an AVI (see Langer et al., 2017).

Gilliland's (1993) applicant reaction model shows that applicants will perceive more procedural justice when they have more opportunity to respond to interview questions immediately, can engage in two-way communication, and are treated with warmth and respect. Since there are fewer opportunities to respond, provide immediate feedback and engage in human interaction in an AVI than in an SVI (Honkaniemi, Tolvanen, & Feldt, 2011; Langer et al., 2017), applicants tend to view the interview procedure as unfair when

conducted via asynchronous media (Blacksmith, Willford, & Behrend, 2016). Therefore, we propose the following hypotheses:

H5: Applicants will perceive AVIs less favourably than SVIs.

H6: Applicants will perceive AVIs to be less fair than SVIs.

2.3 The effect of AI decision agent on applicant fairness perception

AI has become a decision agent used in AVIs (Torres & Gregory, 2018), in which a machine learning algorithm can extract and analyse job applicants' features and predict their performance without human decision bias and inconsistency (Naim et al., 2018). However, machine learning can also reproduce human biases if the developers of such algorithms do not pay close attention to the data and do not adequately train and validate their algorithms (see Caliskan, Bryson, & Narayanan, 2017). Ötting and Maier (2018) argued that AI decision agents may influence employee attitudes, such as procedural justice perceptions, because the decision procedure involves less transparent algorithms with less reciprocation behaviour. Procedural fairness is perceived when applicants feel that they can control the hiring decision process, and applicants perceive more procedural fairness when they believe that they can make their responses appealing to the interviewer; this is called socially desired responding (Honkaniemi et al., 2011). Compared to the human decision agent in AVIs, job applicants have less information about how the AI decision agent makes hiring recommendations based on AVI recordings; therefore, applicants' perceptions of fairness might be lower in AVI-AI settings. We therefore propose the last hypothesis:

H7: Applicants will perceive AVI-AI settings as less fair than AVI settings.

3 Method

3.1 Participants

3.1.1 Applicants

This study received sponsorship from a nonprofit human resources (HR) organization located in China. We followed Langer, König, and Fitili's (2018) method to determine the required sample size, and G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) was used to predict the sample size required to detect an interaction effect in an analysis of covariance (ANCOVA). A sample of N = 179 is necessary to achieve a moderate effect size, f = .25, α error probability = .05, a power of 1- β = .80, numerator df = 3, numbers of groups = 3, and number of covariates = 7. As issues could occur during data collection in the experiment (see Langer et al., 2017), we continued solicitation until our sample consisted of 180 Chinese members from the organization, while the sponsor committed to referring suitable applicants' profiles to specific employer(s) based on the applicants' video interview performance in this study.

To test our hypotheses, we developed an experimental design that included three experimental groups: AVI-AI, AVI, and SVI. The difference between the AVI and SVI groups was synchrony, while the difference between the AVI and AVI-AI groups was the decision agent (human vs. AI). The 180 applicants were randomly allocated to one of three experimental groups, and the order was counterbalanced within each group as shown in Table 1.

Table 1. Composition of the sample

		AVI-AI		AVI		SVI	
Number of applicants		60	100%	60	100%	60	100%
Gender							
	Male	18	30%	21	35%	24	40%
	Female	42	70%	39	65%	36	60%
Age (years)							
	25-29	18	30%	3	5%	3	5%
	30-34	39	65%	42	70%	51	85%
	35-39	3	5%	15	25%	6	10%
Education							
	Bachelor's	21	35%	33	55%	24	40%
	Master's	38	63%	20	33%	35	58%
	Doctorate	1	2%	5	8%	1	2%

3.1.2 Raters

A total of 6 real recruiters agreed to participate in the study as raters of the candidates. The raters included three female and three male professional recruiters, and they were all of the same race (Chinese) to control for possible race effects (see Finkelstein, Demuth, & Sweeney, 2007). The average age of the raters was 40 years, and they had 10 to 15 years of employment selection experience. The raters were compensated with a voucher equivalent to USD100 for their participation in this experiment. The six raters were randomly assigned by gender to rate the interview performance of 10 applicants in each experimental group; thus, each rater evaluated a total of 30 applicants from the AVI-AI, AVI and SVI settings. Each group had one male and one female rater, and each applicant had one rater.

3.2 Procedure

3.2.1 Design

This study employed an experimental design to compare both the applicants' and the raters' responses between the SVI and AVI conditions and between the AVI and AVI-AI conditions (cf. Haan et al., 2017; Straus et al., 2001). In the first stage, three HR professionals at a senior management level (of the 180 applicants and 6 raters) with employment selection experience in the AVI-AI, AVI and SVI settings were invited to participate in a pilot study to ensure that the study questionnaires and hypotheses were appropriate and significant.

The sponsor organization posted a web page that was accessible to its members and that contained a job description (see Fig. 1) for hiring 2-3 HR managers for its affiliated company located in Shenzhen, Guangdong, China. Interested members submitted their resumes to the researchers, and the researchers screened the resumes based on the job description. Then, a total of 180 qualified applicants received a brief

explanation of the study procedure and signed a consent form via email. As promised, the organization referred 30 suitable candidates to the employer based on the applicants' interview performance. The employer invited appropriate candidates for formal face-to-face interviews at its discretion.

Prior to the onset of the experiment, the six raters attended a 2-hour frame-of-reference training session (Roch, Woehr, Mishra, & Kieszczynska, 2012) to review the experimental procedures and to learn how to operate the equipment for each interview setting. Before beginning the formal interviews, all of the applicants participated in one practice trial (time unlimited) using the media according to the online instructions.

To eliminate the impacts of resumes on interview ratings due to expectation bias (see Torres & Gregory, 2018), we did not disclose the applicants' resume information to the raters in this study. In the SVI and AVI settings, the raters were asked to evaluate their initial impression of each applicant and the applicant's physical appearance after the applicant answered the first interview question; the raters also provided an interview score for each answer. Upon completing the interviews, all applicants were asked to answer online questionnaires regarding their feelings of favourability and perceived fairness regarding their respective interview setting.

Job description

Responsibility:

- Work closely with business to understand and meet the recruitment needs;
- Responsible for full spectrum of talent acquisition, including recruitment strategies, headcount planning, identifying the suitable recruitment channels, job posting, CVs screening and shortlisting, conducting interviews and offer management;
- Facilitate effective passive and active talent pipelining through different sourcing strategies; and
- Handle ad hoc Talent Acquisition and HR projects as assigned.

The Successful Applicant

- Bachelor degree with at least 5-10 years of solid recruitment experience of a fast-paced corporate environment and high-volume hiring, good understanding in Hong Kong and South East Asia talent market, professional services firm experience is preferred.
- Excellent communication and consultative skills; with fluency in both spoken and written in English, Cantonese and Putonghua.
- Expertise in recruitment tools, platforms, and social media sourcing techniques.
- Proven negotiation skills, and evidence of forming strong business relationships.
- Ability to thrive in a fast-paced and high-pressure environment.
- Candidate with less experience will be considered as Assistant Manager.

Seniority Level
Mid-Senior level

Industry
Internet

Employment Type
Full-time

Job Functions
Administrative, Human Resources

Fig. 1. Job description

3.2.2 Media tools

The interviews in the AVI-AI and AVI settings were conducted via the Human Resource Digital Assistant (HRDA, 2018), a Taiwan-based asynchronous video interviewing platform with AI algorithms similar to those in Suen, Hung, and Lin's (2019) work. The applicants were required to log into the HRDA website using the access code emailed to them in their invitation from the researchers. The applicants entered the HRDA platform at their leisure through a browser on their PC or mobile device with a web camera and could initiate the interview process at any time of the day, which is how an actual AVI-AI or AVI would be conducted with job applicants.

The SVIs were conducted using Skype (2018) without recording, and both the applicants and the interviewers (the six raters) were required to download the Skype program or application on their computer or smartphone with a web camera before entering the interview. Both parties were located in a convenient place of their choosing while ensuring that the interviewers and applicants were in separate facilities, as in a real SVI setting.

3.2.3 Interviews

All three types of interviews were conducted in a structured manner (see Nolan, Carter, & Dalal, 2016; Torres & Gregory, 2018) in which each participant in each experimental group answered the same questions. All questions were behaviourally orientated to assess the applicants' communication skills based on the HRDA's (2018) structured interview questions, as shown in Table 2. This approach was adopted because communication skills can be easily analysed and compared by both asynchronous and synchronous video media (see Rasipuram et al., 2016) and because communication skills were essential to the job description (see Fig. 1).

Table 2. Structural interview questions and order

Q1: Give me an example of a time when you were able to successfully persuade someone to see things your way at work.

Q2: Have you ever talked to an angry customer? If so, how did you manage the situation?

Q3: Tell me about a successful presentation you gave and why you think it was a hit.

Q4: Describe a time you had to share bad news with your team or have a difficult conversation with a coworker.

Q5: Give me an example of a complex process or task you had to explain to another person or group of people.

In the AVI-AI group, the applicants were told that their entire interview process and responses, including audio and video features, would be recorded and analysed by the AI algorithms to serve as a reference when making a hiring recommendation. The applicants in the AVI group were told only that their interview process would be recorded so that the rater could view it at a later date.

In both the AVI-AI and AVI groups, each question item was displayed on a new screen, and the text interview automatically started when the applicants entered the screen. The questions were presented on the screen one at a time in order, and the applicants were required to answer each question within three (3)

minutes. The applicants could choose to move to the next question within 3 minutes. After 3 minutes, a new screen automatically redirected the applicants to the next question. Including one chance trial, the entire video interview process lasted from 18 to 25 minutes.

In the SVI group, a rater was assigned as the interviewer to conduct the SVI for each applicant and asked the same questions in the exact same order used in the AVI-AI and AI settings. Before the formal interview began, the interviewer told the SVI applicants that there were a total of five open-ended questions and that they had 3 minutes to answer each question. When the allocated time had elapsed, the interviewer interrupted the answer and asked the next question. If an applicant finished answering the question within 3 minutes, the interviewer proceeded to the next question accordingly.

3.3 Measures

3.3.1 Interview score (IS)
Following Swider et al.'s (2016) measures, the interview score consisted of a rater's mechanically combined (average) ratings for the five behavioural interview questions for H1, H2, H3 and H4. In the AVI settings, the raters watched the video recordings and rated the applicants' communication skills for each question. In the SVI setting, the raters evaluated the applicants' communication skills directly during the live video interview. A rating was made after the applicant finished answering each question, and each answer was evaluated using a 5-point rating scale, as shown in Table 3 (Cronbach's $\alpha = .831$):

Table 3. Rating standard for interview scores

Score	Rating standard
5	Superior communication skills; could mentor or teach others
4	Good skills communication; above-average proficiency is apparent
3	Adequate skills in communication; no additional training is needed at this time
2	Marginal skills in communication; more training would be required
1	Not competent in communication; the competency needs substantial development

3.3.2 Applicant initial impression (IM)
Many studies have found that raters make hiring decisions based on an initial impression within the first 4 to 5 minutes of an interview (Swider et al., 2016). Therefore, prior to scoring the first interview answer for each applicant, each rater provided ratings of his or her initial impression of the applicant's suitability, which were used to examine H1 and H3. This measure consisted of four items rated on the 5-point scale (from 1 strongly disagree to 5 strongly agree) previously used by Swider et al. (2016) to assess global evaluations of applicant suitability. An example item was, "This applicant appears to be very qualified" (Cronbach's $\alpha = .886$).

3.3.3 Applicant appearance rating (AA)
After providing their initial impression, the raters' subjective ratings of the applicants' physical appearance were measured for subsequent testing of H2 and H4 using the following item adopted from Behrend, Toaddy,

Thompson, and Sharek (2012): "Rate impression of applicant: Appearance", which used a 7-point scale with anchors from 1 (poor) to 7 (excellent).

3.3.4 Applicant favourability towards the interview process (AF)

Applicant favourability towards the interview process (H5) was measured using ten items adopted from Guchait et al. (2014). The applicants' responses were collected on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). A sample item was, "The interview was a positive experience" (Cronbach's α = .890).

3.3.5 Applicant perceived fairness (PF)

Applicant perceived fairness was measured for H6 and H7 with 13 items on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree) that were adopted from Guchait et al. (2014). A sample reverse item was, "The interview process was free of bias" (Cronbach's α = .860).

3.3.6 Control variables

Due to the design of the study, the apparent effects of the experimental group on different reactions for both applicants and raters could not be interpreted as causal effects, as they might also reflect differences between the respondents in the different groups. Based on the applicants' resumes, we examined whether the gender, age, and education levels of the respondents influenced the results for the experimental groups, which allowed us to determine which factor should be included as a covariate in the analysis of the hypotheses.

To rule out alternative explanations for differences among the groups, we also assessed whether the groups differed in terms of the applicants' responses based on the applicants' interview motivation (MO) and their video interview experience (EP) and whether these should be included as covariates (cf. Langer, König, Gebhard, & André, 2016). Interview motivation was measured on a scale ranging from 1 (does not apply at all) to 5 (does apply) with five items, such as "I take the interview seriously." Video interview experience was assessed using the question, "How many employment video interviews have you participated in?" All of the above questions were presented to the applicants immediately after the interviews were completed. Additionally, differences among the raters were controlled in this study.

3.4 Data analysis

Chi-square analysis, correlation analysis, analysis of variance (ANOVA), ANCOVA, multivariate analysis of covariance (MANCOVA) and multiple linear regression were used in IBM SPSS v23 to examine the hypotheses in this study (cf. Torres & Gregory, 2018). Following Zhang et al. (2017), single confirmatory factor analysis was conducted for each measure, and all factor loadings for all variables were at least .6.

4 Results

The coefficients of the Pearson correlations between the variables are shown in Table 4.

Table 4. Correlation coefficients (n=180)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Gender[a]	--												
2. Age	.070	--											
3. Education[b]	.107	.181*	--										
4. IS (Interview score)	.112	.039	-.020	--									
5. IM (Applicant initial impression)	.014	.131	-.032	.665**	--								
6. AA (Applicant appearance rating)	-.114	-.048	.072	.629**	.534**	--							
7. MO (Interview motivation)	.102	.050	.081	.056	-.087	.094	--						
8. EP (Video interview experience)	-.019	-.119	-.054	-.062	-.092	-.104	-.046	--					
9. AF (Applicant favourability towards the interview process)	.028	-.070	.072	.190*	.157*	.245**	.236**	-.039	--				
10. PF (Applicant perceived fairness)	-.089	.077	-.040	.244**	.291**	.132	.042	.019	.217**	--			
11. SVI (Synchronous video interview)[c]	-.074	.131	.000	.046	.141	.049	-.024	.191*	.536**	.035	--		
12. AVI (Asynchronous video interview)[c]	.074	-.121	.064	-.066	-.083	-.018	-.024	.000	-.194**	.014	-.500**	--	
13. AVI-AI (AVI plus AI-based decision agent)[c]	.000	.102	-.064	.020	-.058	-.032	.048	-.191*	-.342**	-.049	-.500**	-.500**	--

a Male=1; Female=2

b Bachelor's degree=1; Master's degree=2; Doctorate=3

c Categorical variable: No=1; Yes = 2

Notably, applicant initial impression (Mean=3.57; SD=1.08) and appearance (Mean=4.02; SD=1.42) were highly correlated with interview score (Mean=3.23; SD=1.09). This finding was expected given that initial impression and appearance are known to significantly influence rater interview score. Applicant favourability towards the interview process (Mean=3.22; SD=0.73) and perceived fairness (Mean=3.50; SD=0.78) were slightly correlated with interview score and applicant initial impression, suggesting that an applicant's interview performance might affect his or her feelings about the interview process. The correlation matrix showed that applicants exhibited higher favourability towards the interview process when they received higher appearance ratings and had higher interview motivation (Mean=3.75; SD=0.89); therefore, it is possible that appearance rating and interview motivation slightly influenced perceived fairness. Furthermore, the applicants had greater numbers of video interview experiences (Mean=1.40; SD=1.12) in synchronous mode (SVI) than in asynchronous mode (AVI) or asynchronous mode plus AI-based decision agent (AVI-AI), and the applicants reported higher favourability towards the interview process in SVI than in AVI or AVI-AI.

Prior to testing the hypotheses, we used chi-square tests and ANOVAs to examine the differences in the control variables, including gender, age, education, interview motivation, and video interview experience among the three experimental groups. We found no significant differences among the three experimental groups with the exception of education. Thus, only education was included as a covariate in the following analyses.

A one-way ANCOVA was used to examine H1 and H2. Interview score was the dependent variable; synchrony (AVI vs. SVI) was the independent variable; and applicant initial impression, applicant appearance rating and education level were covariates. As shown in Table 5, statistically significant differences were found between applicant initial impression and interview score and between applicant appearance rating and interview score, but the fixed factor of synchrony and the covariate of education level yielded no significant effects on interview score. The results indicated that applicants received higher interview ratings from the corresponding rater when the rater perceived that the applicant had a positive initial impression and an attractive appearance regardless of whether the video interview was synchronous. Thus, H1 and H2 were supported.

Table 5. Test for between-subject effects in the SVI and AVI conditions

Dependent variable: IS

Source	Type III sum of squares	df	Mean square	F	Sig.	ηp2
Corrected Model	49.983[a]	4	12.496	31.576	.000	.523
Intercept	5.388	1	5.388	13.616	.000	.106
Initial impression (IM)	15.000	1	15.000	37.904	.000	.248
Applicant appearance rating (AA)	6.974	1	6.974	17.623	.000	.133
Education	.005	1	.005	.011	.915	.000
Group	.445	1	.445	1.125	.291	.010
Error	45.510	115	.396			
Total	1796.520	120				
Corrected Total	95.493	119				

a. R squared = .486 (adjusted R squared = .468)

To test H3 and H4, we divided the job applicants into four conditions: positive applicant initial impression in the SVI condition, negative applicant initial impression in the SVI condition, positive applicant appearance rating in the AVI condition, and negative applicant appearance rating in the AVI setting. As shown in Table 6, if an applicant's initial impression rating was higher than the mean for applicant initial impression (3.573) in the SVI and AVI conditions, his or her initial impression was classified as positive in this study; otherwise, his or her initial impression was classified as negative. If an applicant's initial impression rating was higher than the mean for applicant appearance rating (4.017) in the SVI and AVI conditions, his or her initial impression was classified as positive in this study; otherwise, his or her appearance rating was classified as negative. Table 6 shows that the mean scores for interview score were higher or lower in the SVI condition than in AVI condition when the applicants' initial impression or appearance rating was relatively positive or negative, respectively. This result indicated that applicant initial impression and applicant appearance rating had stronger effects on interview score in the SVI setting than in the AVI setting. This result suggests that synchrony may have moderated the influence of applicants' initial impression or appearance rating on interview score.

Table 6. Means and SDs of interview score in different conditions

		SVI			AVI		
Initial impression (IM)		N	Mean	SD	N	Mean	SD
> mean = 3.573	Positive	39	4.246	.931	36	4.067	.208
< mean = 3.573	Negative	21	2.914	.916	24	3.276	.692
Applicant appearance rating (AA)							
> mean = 4.017	Positive	30	4.38	.831	18	4.066	.329
< mean = 4.017	Negative	30	3.18	1.047	42	3.614	.647

To test whether synchrony (Z) moderated the relationship between initial impression (X1) and interview score (Y1) or that between applicant appearance rating (X2) and interview score (Y2), we performed two linear regressions. X1, Z, and X1*Z or X2, Z, and X2*Z were included as the independent variables, education level was included as a control variable, and Y1 or Y2 was the dependent variable. A dummy independent variable was created for the SVI group (Z [2,1]), and an ordinal independent variable was used for education level (bachelor's [0]; master's [1]; doctorate [2]). All the variables were standardized before running the regression models.

As shown in Table 7, education level was entered as a control variable in the two separate regression models, but it did not have a significant impact on interview score. The results of the first regression model for Model 1 indicated that interview scores could be predicted by initial impression ratings, and the applicants' average interview scores were better or worse in the SVI condition than in the AVI condition when their initial impression was better or worse, respectively. In other words, the applicants' initial impressions had a stronger effect on interview scores in the SVI condition than in the AVI condition. The results of Model 2 indicated that an applicant's interview score could be predicted by his or her appearance rating. However, there was no significant interaction effect of appearance rating and synchrony on interview score. Therefore, H3 was fully supported, and H4 was partially supported.

Table 7. The regression coefficients

Dependent variable: Interview score (IS)		Standardized β	T	Sig.	R^2
Model 1	Initial impression (IM)	.757	3.606	.000	
	SVI (Synchronous video interview)[a]	.037	.319	.750	.501
	SVI[a] *IM	.394	4.295	.001	
	Education level[b]	-.120	-1.708	.090	
Model 2	Applicant appearance rating (AA)	.575	1.965	.050	
	SVI (Synchronous video interview)[a]	-.057	-.163	.871	.366
	SVI[a]*AA	.011	.134	.893	
	Education level[b]	.052	.113	.910	

a. SVI=2; AVI=1 (n=120)

b. Bachelor's degree=0; Master's degree=1; Doctorate=2

We used MANCOVAs to test H5 and H6. We examined whether synchrony (the independent/fixed variable) explained statistically significant amounts of the variances in applicant favourability towards the interview process and perceived fairness (dependent variables) while controlling for education level (a covariate). The results showed that synchrony significantly affected the dependent variables, $F(2, 116) = 40.511$, $p<.001$, Wilks' $\lambda= .589$, while education level also impacted the dependent variables, $F(2, 116) = 4.157$, $p<.001$, Wilks' $\lambda= .933$. We found that synchrony had a statistically significant effect on applicant favourability towards the interview process [$F(1, 117) = 75.259$; $p < .001$; $\eta p2 = .391$] but not perceived fairness [$F(1, 117) = .497$; $p = .482$; $\eta p2 = .004$]. Education level did not have a significant impact on either favourability towards the interview process ($p = .067$) or perceived fairness ($p = .219$). These findings suggested that the applicants perceived SVIs more favourably than AVIs. However, the applicants' perception of procedural fairness did not differ between the SVI and AVI conditions. Therefore, H5 was supported, but H6 was not.

To test H7, a one-way ANCOVA was used to compare the means for perceived fairness between the AVI (3.454) and AVI-AI (3.515) conditions with the inclusion of education level as a covariate. The results showed that the decision agent (human vs. AI) did not have a significant effect on perceived fairness [$F(1, 117) = .276$; $p = .600$; $\eta p2 = .002$] and that education level did not have a significant effect on perceived fairness [$F(1, 117) = .104$; $p = .748$; $\eta p2 = .001$]. The results indicated that the applicants did not perceive differences in procedural fairness between the AVI and AVI-AI conditions. In other words, the AI decision agent used in the AVI setting did not influence perceived fairness. Therefore, H7 was not supported.

5 Discussion

AVIs have emerged as a common interview modality for initial employment screening (Mejia & Torres, 2018), while AI-based decision agents have also received increasing attention (Ötting & Maier, 2018). Although the advantages of AVIs are clear (see Torres & Gregory, 2018), the unintended social impacts caused by asynchrony and the use of AI-based decision agents in AVIs have not been addressed to the best of our knowledge. This study employed an experimental design to examine the effects of synchrony and decision agent by comparing interview ratings and applicant attitudes between the SVI and AVI settings and comparing applicants' perceptions of fairness between the AVI and AVI-AI settings.

Regarding interview ratings, this study proved that despite the use of a structured behavioural interview setting, a candidate's first impression and physical appearance are advantageous for human ratings regardless of whether video interviews are synchronous or asynchronous (cf. Swider et al., 2016). In addition, in synchronous interviews, the impacts of initial impression and physical appearance rating on interview score are greater when their values are more extreme (either positive or negative). Thus, compared with the synchronous mode, the asynchronous mode can decrease the impressional primacy effect when evaluating a candidate's competencies via video interview.

Regarding applicant perceptions, the applicants reported less favourability towards asynchronous interviews, consistent with Langer et al.'s (2017) findings. Compared to synchronous interview modes that involve human interviewers, asynchronous-based interviews are disliked by many applicants because the applicants must answer questions and watch themselves answering during non-human interactions (cf. Langer et al., 2017).

In contrast to Langer et al.'s (2017) findings, perceived procedural justice was not found to be lower

for AVI settings than for SVI settings or for AVI-AI settings than for AVI settings. One possible explanation may be that the applicants' fairness perceptions reflected computers-are-social-actors theory (CASA; Nass & Moon, 2000), in which applicants perceive computers to be as trustworthy as humans; therefore, neither synchrony nor the AI decision agent was sufficiently salient to influence the applicants' perceptions of procedural justice (see Ötting & Maier, 2018). Another possibility may be that perceived procedural justice in the current study was evoked by different interview questions or through the use of different items to capture procedural justice.

Taken together, the results of our study have several implications for practitioners: 1) Since the validity of a video interview can be impaired by the interviewer's initial impression of the applicant (Swider et al., 2016), asynchronous-based interviewing can be used to decrease the impressional primacy effect and bias, which significantly influences selection decisions by interviewers (Florea et al., 2019). 2) Automatic asynchronous video interviews plus AI decision agent may avoid the procedural justice issue, and this interview modality should be considered as a potential alternative to synchronous-based interviews conducted by human interviewers, which entail higher costs and greater restriction regarding scheduling (Torres & Gregory, 2018). 3) Although there is no justice concern, employers or recruiters should be aware of the disadvantages of using asynchronous interview platforms due to the lower level of human interaction, which may cause withdrawal behaviours in applicants (see Langer et al., 2017). 4) As AVIs using AI decision agents are being adopted by an increasing number of organizations, industrial educators or institutes should carefully consider user training for both interviewees and interviewers in this new context.

This study also offers contributions to research: 1) While most of the video interviewing research over the years has adopted a research survey perspective (see Haan et al., 2017), this study extended and combined media richness theory and social interface theory to explore the impacts of different features of video interviews—synchrony and AI decision agent—on employment selection. 2) To respond to the research need for clarifying how new technologies affect user reactions (McCarthy et al., 2017), this study employed a novel experimental design to compare how both applicants' and raters' reactions are affected by whether video interviews are synchronous or asynchronous. 3) The synchrony of the video interview settings was identified in our study as a new moderator of the relationship between initial impression and interview score. 4) This study may be the first to attempt to explore whether the AI decision agent used in AVIs changes applicants' fairness perception. 5) In comparison to student laboratory studies, this study involved real applicants who had a real interest in performing well in the interviews, and it involved actual recruiters as the raters. However, our results do not indicate that synchrony influenced the applicants' perception of fairness. Additionally, our participants did not respond differently in terms of fairness perception to the AVI-AI and AVI settings, even though they were told that the AVI-AI would involve an evaluation of their verbal and nonverbal cues during the interview in addition to the criteria that are generally evaluated by human interviewers (Nguyen, Frauendorfer, Mast, & Gatica-Perez, 2014). Future research on social computing or human–computer interaction could examine other applicant or rater behaviours that are affected by AI interventions.

Some limitations of this study should be noted. 1) To conduct authentic video interviews, we adopted an HR job posting from a specific company, which might have screened out some types of applicants through self-selection for person-organization fit (Chapman, Uggerslev, Carroll, Piasentin, & Jones, 2005), thus possibly introducing sample selection bias. 2) To control for possible race effects (see Finkelstein et al., 2007) and to answer the call for more international research, this study exclusively involved Chinese respondents, but this approach limits the generalizability of the study results to other culture contexts. Future research

could expand to more populations in different countries. 3) To eliminate contamination due to resumes in this experiment (see Torres & Gregory, 2018), we did not allow the raters to review the applicants' resumes before the interviews. Future research may replicate this study in a more natural setting rather than the employed experimental setting.

6 Conclusions

AVIs paired with AI algorithms are becoming popular in the screening of job candidates. However, there is little evidence regarding whether the features of synchrony and AI decision agents can improve employment screening beyond cost and time savings. This study is among the first attempts to explore the effects of synchrony on interview ratings and job applicants' attitudes and the effect of AI decision agents on job applicants' perception of fairness. The present findings show that AVIs can lessen the impressional primacy effect among raters. Although asynchronous media decrease applicants' perceptions of favourability towards the interview process relative to that under the SVI modality, neither synchrony nor the AI decision agent generated fairness concerns among the applicants. These results suggest that AVIs with or without an AI decision agent can be implemented for effective candidate screening. For follow-up studies, we recommend investigating the differences in reliability and validity between AI decision agents and human raters and attempting to better understand whether AI assessment results can change human decision making in employment selection.

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107年度專題研究計畫成果彙整表

計畫主持人：孫弘岳	計畫編號：107-2511-H-003-040-MY2

計畫名稱：人工智能與同步效應對面試官和應徵者在不同視訊面試媒介之反應研究

成果項目			量化	單位	質化 （說明：各成果項目請附佐證資料或細項說明，如期刊名稱、年份、卷期、起訖頁數、證號...等）
國內	學術性論文	期刊論文	0	篇	
		研討會論文	0		
		專書	0	本	
		專書論文	0	章	
		技術報告	0	篇	
		其他	0	篇	
國外	學術性論文	期刊論文	4	篇	Suen, H.Y., Hung, K.E., & Tseng, F.H.* (2020). Employer Ratings through Crowdsourcing on Social Media: An Examination of U.S. Fortune 500 Companies. Sustainability, 12(16):6308. (*Corresponding Author) (SSCI/SCIE)。 Suen, H.Y., Hung, K.E., & Lin, C.L.* (2020). Intelligent video interview agent used to predict communication skill and perceived personality traits. Human-centric Computing and Information Sciences, 10, 3. (*Corresponding Author) (SCIE)。 Suen, H.Y., Chen, M.Y.C., & Lu, S.H.* (2019). Does the use of synchrony and artificial intelligence in video interviews affect interview ratings and applicant attitudes? Computers in Human Behavior, 98, 93-101. (*Corresponding Author) (SSCI)。 Suen, H.Y., Hung, K.E., & Lin, C.L.* (2019). TensorFlow-based Automatic Personality Recognition Used in Asynchronous Video Interviews. IEEE Access, 7(1), 61018-61023. (*Corresponding Author) (SCIE)。
		研討會論文	6		Suen, H. Y., & Nien, C. F.* (2019).

		專書論文		章	The impacts of synchrony and artificial intelligence agent on interviewees' impression management in video interviews. The 2nd International Cognitive Cities Conference (IC3 2019), Kyoto, Japan. Suen, H. Y., & Yao, Y. C.＊(2019). Automated prediction of communication skill in asynchronous video interview enabled with artificial intelligence decision agent. The 2nd International Cognitive Cities Conference (IC3 2019), Kyoto, Japan. Suen, H. Y., & Zeng, Y. T. (2019). Interviewing with a machine: Perception and skills gap from the point of view of job applicants. The 13th International Conference on Technology Education (ICTE 2019), Cheongju, South Korea. Suen, H. Y., & Hung, T. H. (2019). AI interviewer vs. human interviewers: Accuracy rating of candidates' personality. The 13th International Conference on Technology Education (ICTE 2019), Cheongju, South Korea. Suen, H. Y., & Chien, E. T. (2019). Crowdsourced employer ratings: Lessons from Glassdoor. The 13th International Conference on Technology Education (ICTE 2019), Cheongju, South Korea. Suen, H. Y., & Chen, Y. A. (2019). Synchronous interviews vs. asynchronous interviews for personality rating. The 13th International Conference on Technology Education (ICTE 2019), Cheongju, South Korea.
		專書	0	本	
		專書論文	0	章	
		技術報告	0	篇	
		其他	0	篇	

參與計畫人力	本國籍	大專生	0	
		碩士生	6	錢恩才、曾郁婷、洪廷豪、陳怡安、堯翊淇、粘瀞方
		博士生	0	
		博士級研究人員	0	
		專任人員	0 人次	
	非本國籍	大專生	0	
		碩士生	0	
		博士生	0	
		博士級研究人員	0	
		專任人員	0	

其他成果 （無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。）	1. 本計畫著重在以微表情模擬性格自評與面試官的印象，並成功運用科技部的補助，將研究結果與鳳凰互動科技股份有限公司(未上市公司，簡稱鳳凰科技)進行產學合作，開發出HRDA（非同頻視訊面試結合AI性格自判的軟體，https://hrda.pro），並在中國大陸(廠商募資考量)以福建省伯樂仁資智能有限公司申請第一階段的專利。已導入的客戶包括大江(8436), 中鋼(2002), 中租-KY(5871), 中鼎(9933), 巨大(9921), 國泰金(2882), 華碩(2357), 橘子(6180), 春水堂(未上市), 信義(9940), 震旦行(2373)等標竿企業。 2. 指導學生(前科技部計畫兼任研究助理)參加2018中國大陸召集臺港澳及來自全球各地的頂尖大學，所舉辦最大規模的創新創業競賽「建行盃第四屆中國互聯網+大學生創新創業大賽」。從初賽一共64萬支世界各地的參賽隊伍中晉級，於10月15日在廈門大學進行決賽，再從382支隊伍中脫穎而出，以「AI應用在人資面試」獲頒銀獎殊榮。並榮獲優秀創新創業導師獎。 3. 計畫亦取得震旦行(2373)的承諾，已與鳳凰科技簽署代銷合約，將於未來四年將本計畫研究成果結合產學合作的商品，同時在兩岸三地推動本計畫與鳳凰科技產學合作產品的市場業務。 4. 協助產學合作廠商鳳凰互動科技股份有限公司在中國大陸設立的公司福建省伯樂仁資智能科技有限公司取得視頻面試方法與系統的專利。(專利號碼：201811033117.4)。專利發明人為伯樂智能科技總經理洪國恩先生與本案計畫主持人孫弘岳博士。