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幸福感的客觀測量

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現有的幸福感研究大多偏向相關性研究，主要依賴心理量表來量測主觀的幸福感受。基於幸福感可能涉及的情緒歷程，本研究進而探討情緒偵測和情緒側化與幸福感之關聯，並藉此發展兩項以「知覺作業」為基的行為實驗典範。第一項實驗中，我們利用「不連續閃光抑制作業」探討無意識情緒偵測與幸福感之關聯，初步研究結果顯示：相較於男性，情緒偵測越敏銳的女性，越容易有正向的人際關係，以及較高的幸福感程度。第二項實驗中，我們利用「雙穩動態知覺作業」探討情緒腦側化與幸福感之關聯，初步結果顯示：雙腦連結度越高者，越能夠應對壓力，且具有較緊密的正向關係、較顯著的個人成長，以及較高的幸福感。整體而言，本研究試圖找出與幸福感相關的「知覺關聯」（perceptual correlates），期待相關結果能進一步發展成比較穩定且可避免主觀偏誤的行為量測典範，並提供和主觀幸福感互補的客觀資訊。

關鍵詞：行爲測量、幸福感、情緒、實驗典範

近年新冠肺炎疫情使得人們生活方式產生巨變，長期保持社交距離更嚴重影響人民的生活品質以及整體生活滿意程度。根據世界衛生組織（WHO）的定義，健康不僅是免於疾患，而是「身體」、「精神」和「社會福祉」全面性的完整。雖然幸福感的研究於 1950 年代後蓬勃發展，但近代幸福感的研究多著重於自陳式報告的結果，從實驗角度探討幸福感的研究相對較少。有鑒於情緒和幸福感程度之間的關聯，本論文將回顧與情緒相關並著重生理測量的幸福感實驗，探討情緒偵測及情緒腦側化與幸福感的關聯，並透過行爲實驗找尋幸福感的「知覺關聯」，進而提出綜合性討論以及未來研究方向。

（一）幸福感的定義

當代關於幸福感的討論及相對應的測量可粗分爲「主觀」以及「客觀」兩大類。主觀測量強調個人經歷和成就感，其高低是由個體的主觀判斷所決定，根據參考理論所著重的面向，幸福感的主觀測量又可分爲兩個派別：至福主義（eudemonism）和正向主義（hedonism）。前者主張「心理幸福感」（psychological well-being）的關鍵在於尋找生命意義和體驗個人成長；後者則強調「主觀幸福感」（subjective well-being）主要是來自身心快樂和對自己的生活滿意度（Martín-María et al., 2017; Steptoe et al., 2015）。兩者的判斷指標皆包含：個體的正向情緒、負向情緒、以及整體生活滿意度（陸洛，1997; Andrews & Withey, 1976; Diener & Emmons, 1984; Diener et al., 1999），相較於主觀幸福感所注重的短暫感受，心理幸福感則更加強調長期的心理狀態（Burns & Machin, 2010）。儘管至福主義和正向主義之間存在概念上的差異，但它們應以協同方式共同發揮作用，而非相互排斥。事實上，心理幸福感與主觀幸福感這兩種幸福感之間的關聯已在許多研究中得到證實（Biaobin et al., 2004; Keyes et al., 2002; Linley et

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al., 2009），同時在近代的幸福感心理學實徵研究中，兩者間的疆界逐漸淡化，故在本篇研究中主觀幸福感和心理幸福感將被視爲同義詞。

相較於主觀測量，客觀測量則根據生活質量指標定義幸福感，例如物質資源（收入、食物及住房）和社會屬性（教育、健康、政治聲音、社交網絡及聯繫）（Western & Tomaszewski, 2016）。這些客觀指標通常反映了個體上的差異，包括個人的能力和環境中提供的機會（Sen, 2005）。奠基於此，「關係幸福感」進一步強調幸福感深受人際關係的影響，且視幸福感爲「通過個體和社會／環境結構動態交互作用」的歷程（White, 2017）。整體而言，主觀測量通常著重於相關性研究，亦即找出各種和幸福感相關的因子；客觀測量則較著重於理論建構，亦即找出幸福感在理論上應該納入的判斷指標。

（二）幸福感的生理研究

在幸福感測量的範疇內，除了使用自陳式量表，近年學者亦嘗試透過腦部以及生理反應測量幸福感。由於幸福感所涉及的內容廣泛，爲了有效探索，過去的研究大多採取侷限式的化約策略：亦即把幸福感化約成各種可用以調控幸福感的認知能力（例如情緒、壓力、焦慮、憂鬱、獎賞等），然後再以這些認知能力的相關生理反應作爲代表幸福感的指標。化約策略的好處在於研究者得以排除受試者回報時的主觀因素，改成直接針對目標成分進行客觀量測。基於此，多數相關研究皆使用「以作業爲基」（task-based）的方式進行研究。在衆多認知能力中，又以情緒與幸福感程度最爲相關。事實上，過去已有大量研究探討情緒感知對於心理幸福感的影響。例如 Fredrickson 和 Joiner（2002）的研究發現正向情緒能提升幸福感以及其他令人滿意的結果。相反地，負面情緒通常和幸福感低落以及令人不滿意的結果有關聯（Watson et al., 1988）。整體而言，經歷相對高水平的正向情緒和相對低水平的負向情緒（在一定範圍內）是構成健康心理的關鍵因素之一。故以下將分別介紹以情緒爲測量因子探討幸福感程度之生理相關實驗的研究成果。

首先，腦造影研究透過不同的作業指出情緒處理與幸福感息息相關（回顧見 Houben et al., 2015）。例如，在 van Reekum（2007）等人的一項研究中，受試者在觀看一系列情緒刺激後根據指導語進行情緒判斷（負向或是中性），腦部掃描後也接受自陳式的幸福感問卷測量。該研究結果顯示：相較於中性刺激，判斷負向刺激的速度越慢，腹側前扣帶皮層（ventral anterior cingulate cortex）的活化反應就越強，同時其幸福感自陳報告的分數也越高。換言之，在面對負向刺激時，幸福感指數較高的受試者或許更能有效的運用腹側前扣帶皮層去進行應對。近期 Ren 等人（2019）的一項研究亦發現，相較於中性刺激，受試者在觀察負向刺激時，其右側扣帶皮層（right cingulate cortex）、左側顳內回（left medial temporal gyrus）和左側角回（left angular gyrus）的活化程度與自陳式報告的幸福感呈正相關。

此外，Cunningham 和 Kirkland（2013）的一項研究發現幸福感高的人在觀看正向刺激時，其杏仁核（amygdala）的活化程度較大，而且杏仁核活化程度亦和壓力賀爾蒙可體松（cortisol）的變化呈正相關（Urry et al., 2006）。換言之，上述腦區活化程度越高時，幸福感指數也越高。基於這些腦區與其他控制認知功能之腦區的相互關聯，此結果暗示高幸福感者可能更擅於透過注意力轉換或是行爲抑制去減低負向刺激所帶來的影響。

除了活化強度，腦部反應的持續性亦爲重要的測量指標之一。爲測得反應的持續性，過去研究大多使用「情緒調節作業」（emotion regulation task），作業中常以情緒性的圖片爲刺激，並要求受試者在觀看情緒刺激時進行情緒調節（例如維持、注意、強化、或是抑制當下情緒）。此類研究發現，當受試者的幸福感自我評量分數越高，他們在進行情緒調節作業時的腹側紋狀體（ventral striatum）反應也會越強烈且持久（Heller et al., 2013）。左側杏仁核（left amygdala）活化長度也和正負向情緒產生的次數呈正相關（Puccetti et al., 2021），甚至能預測受試者的「神經質」（neuroticism）程度（Schuyler et al., 2014）。

基於幸福感和情緒的緊密相關，亦有研究進一步探討幸福感與情緒疾患（焦慮／憂慮）之間的關聯。研究發現重度憂鬱症患者的伏隔核（nucleus accumbens）活動變化和其處理正向情緒的能力相關（Heller et al., 2009）；右外側前額葉皮質（dorsolateral prefrontal cortex）的活躍程度甚至可以預測未來的憂鬱症病情惡化程度（Heller et al., 2013）。不僅是情緒圖片，透過比較中性圖片（例如：沉思、發呆及散步等圖片）、人際關係圖片（例如：家庭、友誼及伴侶相關圖片）、以及個人活動圖片（例如：個人放鬆、獎勵及成就等相關圖片），研究亦指出幸福感指數涉及之神經迴路和處理獎勵相關的腦區大幅重疊（Jo et al., 2019）。整體而

言，幸福感相關之神經機制可能存在於深處腦區，包括扣帶皮層、杏仁核、紋狀體以及數個大腦皮質區，例如顳內回（medial temporal gyrus）、角回（angular gyrus）和前額葉皮質（prefrontal cortex）。

除了腦造影，過去研究也試圖透過測量其他生理反應來量化幸福感。例如 Schaefer 等人（2013）的研究發現，受試者觀看會引發負面情緒的圖片時，皺眉肌（corrugator supercilli）對巨大聲響的肌肉收縮反應大小和受試者在生命目標（purpose in life）的自評分數呈現負相關；換言之，自我生命目標評分越高的受試者，其在觀看負面情緒圖片時因聲響而造成的皺眉肌反應就越小。此外，皺眉肌的收縮反應和眨眼反射也和側化腦訊號的強度相關，並且也可以反映出婚姻壓力的大小（Jackson et al., 2003; Lapate et al., 2014），這些結果也更強化了皺眉肌反應與幸福感相關腦區反應的一致性。

（三）認知作業的探索

奠基於情緒之於幸福感的重要性，我們提議透過情緒相關的行為典範探索客觀測量幸福感的可能性。事實上，情緒向來深受「上而下」（top-down）以及「下而上」（bottom-up）歷程的影響。「上而下」的影響意指情緒的產生可以來自個人對記憶、目標或內心狀態的評估（Frijda, 1988; Scherer, 2001, pp. 92-120）；「下而上」則意指由外在物理刺激引發情緒。

一般而言，「上而下」強調認知評估的重要性，且過去研究指出認知評估能有效減少負面情緒（Eippert et al., 2007; Gross, 2002; McRae et al., 2010; McRae et al., 2011; Ray et al., 2010）和降低對成癮物質相關的渴望（Kober et al., 2010）。此歷程亦和中央神經（杏仁核活化）以及周邊神經生理的反應息息相關（Dillon & LaBar, 2005; Eippert et al., 2007; Jackson et al., 2000; Kalisch, 2009; Kim & Hamann, 2007; Ray et al., 2010; Walter et al., 2009）。整體而言，使用認知評估，是維持正向情緒、降低負向情緒的關鍵，同時也和人際交往能力以及更高水平的幸福感相關（Aldao & Nolen-Hoeksema, 2010; Gross & John, 2003）。

除了「上而下」歷程，情緒也深受「下而上」歷程的影響。在過去的實驗中，自「下而上」的情緒產生通常涉及視知覺，原因是在所有不同知覺類型中，視知覺所提供的訊息量相對豐富，且從演化的角度而言，某些視覺刺激通常被認為具有威脅性（Seligman, 1971）。簡單而言，視知覺被定義為由視覺刺激的接收（感覺功能）到執行後續認知（特定的心理功能）的整個過程。過去一系列的研究顯示：視知覺和情緒處理是一個雙向影響的過程。例如當受試者身處於紅色房間時，與警覺性有關的腦電波（β 波）出現頻率會增加（Sroykham et al, 2014）；觀看較大尺寸的物體會增加象徵情緒波動的膚電反應（physical galvanic skin response）（Codispoti & De Cesarei, 2007）；觀看尖銳形狀的刺激會強化恐懼感相關腦區（杏仁核）的活化（Bar & Neta, 2007）。另一方面，低階視知覺也受到情緒知覺的影響。例如特定情緒（恐懼）的促發，會增強對後續視覺刺激的敏感程度（有較低的對比能見度）（Phelps et al., 2006）；恐懼表情可以增強低空間頻率（low spatial frequency）的視知覺偵測能力，同時降低高空間頻率（high spatial frequency）的視知覺偵測能力，中性情緒以及厭惡表情則會增強高空間頻率視知覺偵測，並降低低空間頻率視知覺偵測（Nicol et al., 2013）；處於悲傷的情緒，亦會導致觀察者高估距離以及坡度（Riener et al., 2011）。

整體而言，情緒和低階視知覺具交互作用 ，且情緒和幸福感程度息息相關。在此面向上，過去已有不少研究透過腦造影或是周邊生理反應的方式來量化幸福感，然而目前仍缺乏能輔助測量幸福感的行為典範。相較於神經關聯，行為測量的好處在於快速與簡單，且能避免自陳式報告中容易產生的主觀偏誤。此外，由於「低階知覺作業」相關的典範測得的反應相對穩定，不易受到高階認知、信念和情境波動的影響，同時也較能反映出神經系統的個體差異，在幸福感具有多重定義，且容易受到潛在因子共變的情況下，發展幸福感相關之「低階知覺作業」行為典範將為本論文之重點。

（四）幸福感與情緒偵測之關聯

雖然幸福感高低和情緒資訊的處理歷程有關，但機制仍尚未釐清：個體的幸福感指數差異可能來自 (1)「上而下」情緒評估的差異；以及 (2)「下而上」情緒刺激感知的差異。此外，幸福感之於情緒刺激感知的差異是發生在意識之前或是之後亦無定論。考量到意識的角色，我們假設幸福感高低與情緒處理的關聯可能來自於 (1) 不同幸福程度的受試者在意識到刺激「後」才產生不同的上而下情緒評估；或是 (2) 不同幸福程度的受試者在意識到刺激「前」的下而上資訊處理歷程中就已經先有差異。

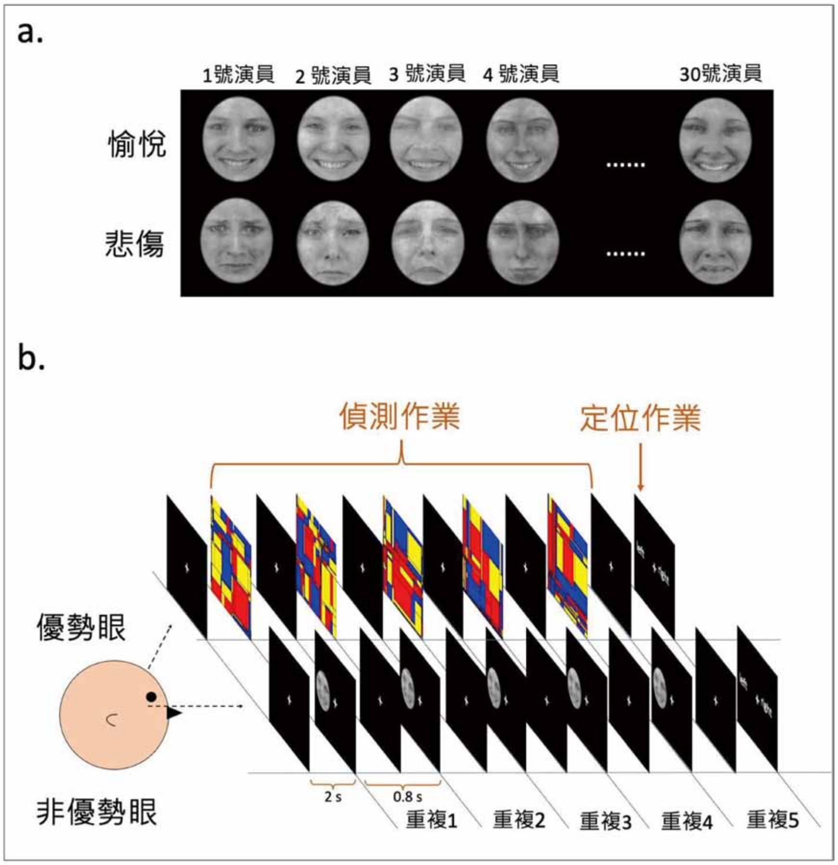
關於上述兩種可能性，曾有學者透過情緒促發典範

（emotion-priming paradigm）進行研究，結果顯示：相較於中性情緒，當啓動詞（prime word）爲正向情緒相關時，幸福感高、低分組具相同強度之晚期正電位活化（late positive potential, LPP）；然而當啓動詞（prime word）爲恐懼情緒相關時，低分組的的促發效果顯著大於高分組，整體結果顯示，相較於高水平幸福感者，低水平幸福感者對於負向刺激更爲敏感（Yu & Li, 2012）。

然而，該研究並沒有直接操弄受試者對於刺激物的視覺意識，因此難以回答不同幸福程度的受試者對於刺激物的處理差異是發生在視覺意識出現之前或之後。有鑒於此，在近期的一項實驗中（Feng et al., 2022a; submitted），我們進一步假設：不同幸福程度的受試者在情緒上的差異會受到個體意識到刺激「前」的下而上資訊處理歷程所影響。根據此假設，我們預測受試者在沒有意識到視覺情緒刺激的情境中亦能處理該資訊，且受試者對於情緒刺激的視知覺閥値應該會和幸福感程度相關。

在此實驗中，刺激涵蓋 60 張取自 KDEF database（Goeleven et al., 2008）的情緒臉孔，其中愉悅以及悲傷的情緒臉孔各半，且男性以及女性的臉孔各半。爲避免低階視覺參數的潛在干擾，我們使用 SHINE toolbox（Willenbockel et al., 2010）平衡情緒臉孔之低階視覺參數（例如顏色、明亮、對比程度），並透過橢圓裁減去除可辨識之個人特徵（例如髮型）（圖 1a）。行爲典範則採用「不連續閃光抑制作業」（dis-continuous

圖 1
實驗刺激與不連續閃光抑制作業典範



註：(a) 實驗刺激。(b) 不連續閃光抑制作業流程：每個嘗試次始於兩秒鐘的空白畫面，接著優勢眼接收彩色方格，同時非優勢眼接受情緒臉孔刺激並維持 0.4 秒，隨後雙眼刺激即消失 0.4 秒，此一流程在完整的嘗試次中將重複五次。過程中若受試者偵測到情緒臉孔則按下 Y 鍵，且在最後階段回報情緒臉孔的出現位置（刺激出現在中央十字的左側或右側）；若無偵測到情緒臉孔，則在最後回報階段隨意按壓左鍵或是右鍵。

flashing paradigm, d-CFS; Hung & Hsieh, 2021）。此作業涉及雙眼競爭的原理：在受試者的優勢眼呈現一系列動態變化的圖像（彩色方格），而在非優勢眼呈現靜態目標刺激（情緒臉孔），並且以不連續的方式呈現（閃爍五次）。在每個嘗試次中，個體會因彩色方格的呈現而無法在意識上覺知到情緒臉孔（圖 1b）。根據受試者的行爲表現，被彩色方格抑制之情緒臉孔的視覺對比強度將逐步以階梯式程序（staircase procedure）進行調整，最終可獲得每一位受試者對於情緒臉孔的知覺閥值。

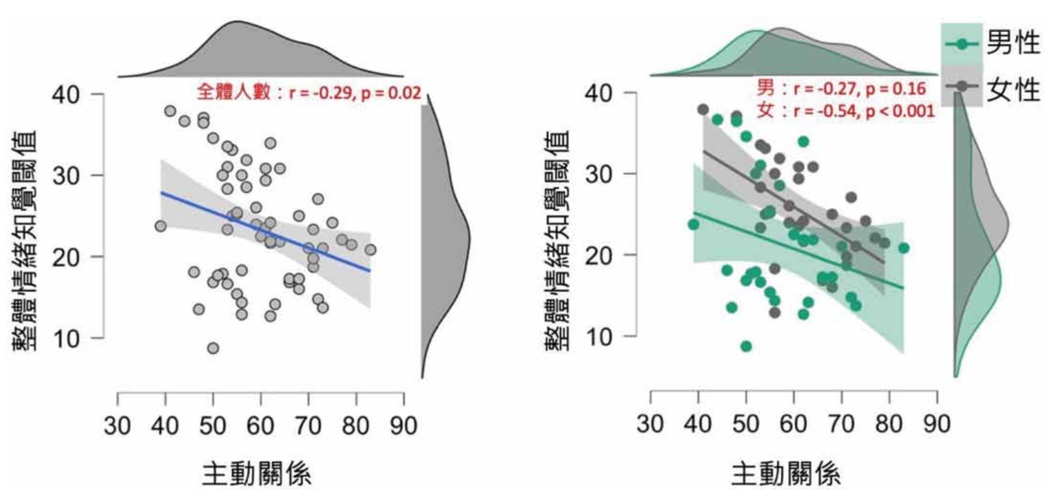
另一方面，爲獲得受試者的幸福指數，我們採用心理幸福感問卷（psychological well-being scales, PWBS），此問卷奠基於心理幸福感六大結構，共含有六個分測驗，包含自我接納（self-acceptance, SA）、主動關係（positive relationship with other, PR）、環境控制（environmental control, EC）、生活目標（life goal, LG）、自主（autonomy, AU）和個人成長（personal growth, PG）。整體而言，「自我接納」指對自我的積極態度（無論是否是自己的過錯都接受自我）；「主動關係」指人際關係，和強烈的同理心相關；「環境控制」指在利用機會滿足個人要求的同時處理環境因素的能力；「生活目標」的特點是目標感、對目標的承諾、以及對自己生活的堅定信念；「自主」指的是自決和應對壓力的能力；「個人成長」指的是持續進步、對新方法的開放性和自我效能。考慮到每個分量表的獨特性，在數據分析中每個向度皆分別計分。此外，過去文獻曾指出歸屬需求以及心理韌性皆和幸福感息息相關（Ifeagwazi et al., 2015; Smith et al., 2007），因此本實驗也透過歸屬量表（need to belong scale, NTBS; Leary et al., 2013）以及簡版復原力量表（brief resilience scale, BRS; Friborg et al., 2006）取得每位受試在歸屬需求以及復原能力上的分數。最後，由於情緒處理以及幸福感受程度（Roothman et al., 2003）深受性別的影響，我們同時探討兩性在幸福感以及情緒偵測關聯上的差異。

此實驗一共蒐集 60 位參與者（男性 30 位；女性 30 位），兩性平均年齡分別爲 23.13 歲以及 23.26 歲。結果顯示：當以歸屬需求以及復原能力爲控制變項進行淨相關分析時，「主動關係」分數和情緒知覺閥值呈顯著的負相關。且此效果主要來自女性。整體而言，本研究支持我們的假設：幸福感程度（主動關係得分）越高者，對情緒臉孔的偵測越敏感。

（五）幸福感與腦側化情緒處理之關聯

除了檢驗情緒偵測能力之外，我們認爲亦可探索其他面向的知覺作業，特別是和情緒腦側化表現有關的知覺與認知歷程。根據情緒處理與幸福感之關聯，Davidson 等人進一步假設維持正向與降低負向情緒的

圖 2
情緒知覺閾值與幸福感之淨相關結果



註：(a) 以全體受試者爲樣本，淨相關結果顯示：知覺情緒臉孔的閥值和幸福感中「主動關係」的總分呈顯著負相關。(b) 女性受試者中，知覺情緒臉孔的閥值和幸福感中「主動關係」的總分呈顯著負相關（灰色），然而此結果並未在男性受試者中發現（綠色）。圖示中，橫軸爲主動關係的分數，縱軸爲整體情緒知覺的閾值。

能力是由不同的神經迴路負責，前者對應負責協助維持正向情緒的「趨近系統」（approach system），而後者則對應腦中負責協助脫離負面情緒的「抽離系統」（withdrawal system），且如同其他認知功能，此兩項能力皆具有「側化」（lateralization）的現象。根據此假設，如果此兩項能力側化在大腦的不同側，那麼受試者在處理情緒資訊時的個體差異，將會反映在左右兩側額葉活動的不對稱性上。

多個研究團隊確實發現與此假設一致的證據：腦電圖（EEG）顯示出左右兩側額葉活動的差異大小，的確和個體處理負向情緒的能力相關。這種左右腦的不對稱性還包括臉部表情辨識的能力側化於右側顳上溝（superior temporal sulcus）（De Winter et al., 2015）以及右側梭狀臉孔腦區（fusiform face area）（Dien, 2009）。腦側化亦可以用來預測受試者對於情緒刺激的反應及幸福感（Dalton et al., 2002; Hsieh et al., 1999; Jackson & Burgess, 2000; Ochsner et al., 2002）。

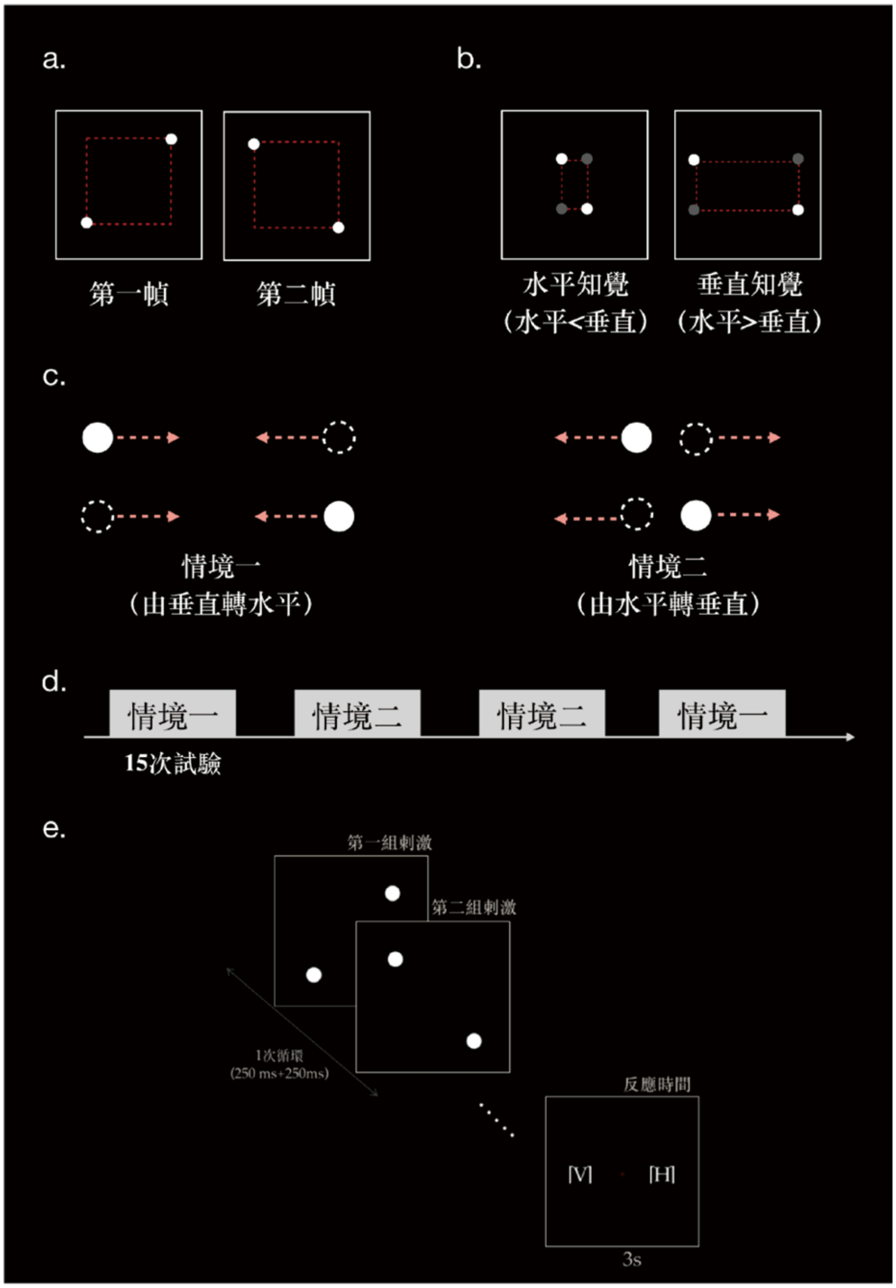
因此，在近期的另外一項實驗中（Feng et al., 2022b; submitted），我們決定進一步探究過去發現的情緒處理側化現象和幸福感的關聯性，以及此關聯性是否能透過低階知覺作業進行量測。根據過去的研究，右腦理論（right hemisphere hypothesis）認爲情緒知覺偏向由右腦處理（Smith et al., 2005），相較之下，向性理論（valence hypothesis）則認爲左右腦分職處理不同向性的情緒：右腦偏向處理負向情緒，而左腦偏向處理正向情緒（Prete et al., 2015）。雖不同理論的內容稍有出入，但研究指出雙腦連結程度（interhemispheric connection）和情緒（表情）處理的程度成正相關（Frässle et al., 2016; Tamietto et al., 2006）。例如Tamietto 等人（2016）的研究發現：不論正負向性，當左右視野同時呈現向性一致的情緒臉孔（雙重目標），受試者的反應會比只呈現在單側視野的單一目標偵測來得快，此現象可能和雙腦連結與神經活化的求合機制（neural summation）有關。利用磁振照影，Frässle 等人（2006）也證實雙腦間的訊息整合程度對於早期臉部視覺偵測能力有決定性的影響。奠基於「雙腦連結—情緒處理」以及「情緒處理—幸福感」此兩項關聯之上，我們試圖透過此實驗（Feng et al., 2023b; submitted）探討左右兩側半腦連結程度是否與幸福感指數相關。

在這項實驗中，我們使用雙穩動態知覺作業（bistable motion paradigm）來估測兩側半腦之間的連結程度（Genç et al., 2011; Tan & Hsieh, 2013）。雙穩定動態知覺現象（bistable motion）屬於視覺表觀運動（apparent motion perception）的一種。視覺表觀運動又稱似動現象，通常會在刺激於不同位置之間來回閃爍時產生。其感知原理可能涉及完形知覺（gestalt perception）以及時序整合（temporal integration）。類型又可分爲短程和長程兩種：短程的特色是刺激位移距離較短或是閃爍速度快，通常和低階視覺特徵的動態知覺處理歷程有關；長程的特色則是刺激位移距離較遠或是閃爍速度慢，通常和高階的視覺整理歷程有關（Grossberg & Rudd, 1992）。在經典的實驗典範中，雙穩定動態知覺的誘發來自兩組位於隱形示意方框（圖3a 紅色虛線處）之對角線上的刺激不斷相互替換（圖3a 第一幀及第二幀）。知覺上，觀察者會看到刺激沿該隱形示意方框的軌跡進行垂直或是水平移動。透過測量這個隱形示意方框的邊長，進一步計算出「雙邊比例」（aspect ratio, AR）：水平長度除以垂直長度；且知覺改變（水平轉垂直或是垂直轉水平）的轉換點（switch point）將能使用雙邊比例進行量化。此轉換點的雙邊比例數值雖主觀且個體差異大，但對個體來說卻是一個非常穩定的現象。

過去研究指出，當水平距離「小於」垂直距離時（雙邊比例 < 1），個體較容易產生水平運動知覺；反之，當水平距離「大於」垂直距離時（雙邊比例 > 1），個體較容易產生垂直運動知覺（圖 3b）。通過操縱四個點之間的距離，可以測量到每個觀察者在視運動方向出現感知切換時的雙邊比例。雙邊比例已被證實與雙腦之間的相互作用有關，更高的雙邊比例表示更大程度的雙腦連結（Kohler et al., 2008; Genç et al., 2011），因此我們希望以此作爲量測指標，用於研究雙腦連結與幸福感之間的關係。此外，爲避免潛在的干擾因素，隱形示意方框邊長比的操弄從兩個方向進行（亦即有兩種情境）：系統性「遞減」或是「遞增」水平距離（期間垂直距離永遠維持不變）。當垂直距離固定且水平距離遞減時（情境一，圖 3c 左），受試者的感知最終將由垂直轉爲水平；當垂直距離固定且水平距離遞增時（情境二；圖3c右），受試者的感知最終將由水平轉爲垂直。實驗期間，兩種情境的順序採平衡設計。

爲獲得受試者的幸福指數，我們採用心理幸福感問卷，此問卷共含有六個分測驗。基於各向度之獨特性，後續分析除了計算總分（SUM）外，同時也使用分項計分。此外，過去研究指出個人特徵包含歸屬感（Smith et al., 2007）、復原力（Ifeagwazi et al., 2015）以及抑鬱程度（Gander et al., 2013）都與幸福感息息相關。因此在本研究中，也使用了歸屬需要量表（NTBS;

圖 3
實驗刺激、實驗情境與雙穩動態知覺典範



註：(a) 透過不斷相互替換兩組位於隱形示意方框（紅色虛線處）之對角線上的刺激（第一幀及第二幀），雙穩定動態知覺得以被誘發。(b) 所知覺到的方向取決於隱形示意方框的雙邊比例：當水平距離小於垂直距離，觀察者容易知覺到水平運動；反之，當水平距離大於垂直距離，觀察者容易知覺到垂直運動。(c) 情境種類和相對應之操弄方式。情境一（垂直轉水平）：兩組圓點相內靠攏（水平距離遞減）。情境二（水平轉垂直）：兩組圓點相外擴張（水平距離遞增）。(d) 情境順序採平衡設計。(e) 刺激配置與試驗流程（trial procedure）：作業中，動態知覺透過兩組位於對角線之白色圓點交互閃爍來誘發（第一幀及第二幀），每幀停留 250 毫秒，故一次循環爲 500 毫秒。每個嘗試次包含五次循環，總長爲 2.5 秒，結束後受試者須在回答看到水平運動知覺或是垂直運動知覺。

Leary et al., 2013）、簡短復原力量表（BRS; Friborg et al., 2006）和貝克焦慮量表（BAI; Steer & Beck, 1997）。

此實驗資料共涵蓋 56 位參與者（男性 28 位；女性 28 位），平均年齡為 22.61 歲。所有實驗參與者的（矯正後）視力皆正常，無遺傳慢性病或精神疾病。結果發現：當以歸屬需求、復原能力，以及憂鬱程度為控制變項進行淨相關分析時，透過情境一所測得之雙邊比例（AR_v）和「獨立」、「個人成長」以及「幸福感總分」正相關。換言之，雙腦連結度越高者，越能夠應對壓力，且具有較緊密的正向關係、較顯著的個人成長、以及較高的幸福感。過去研究指出兩側半腦連結度越高時，越有助於傳遞左右半腦中的資訊（Ringo et al., 1994），基於雙腦連結之於情緒偵測的助益（Tamietto et al., 2006）以及本實驗資料，我們推論雙腦連結程度亦有助於提升幸福感指數，並期望在未來透過後續實驗檢視兩者的因果關係。

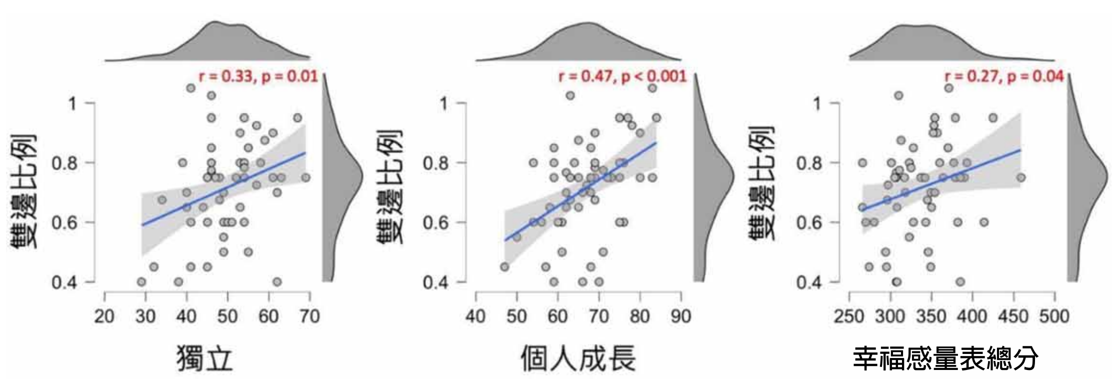
（六）綜合討論與未來研究建議

綜上所述，本文旨在回顧幸福感之神經生理實驗，並探索能夠量化幸福感程度的行為典範。為避免潛在的混淆變項，我們採用低階視知覺典範來作為幸福感的輔助測量工具。初步結果顯示：越擅長偵測情緒臉孔的女性（知覺情緒臉孔的閥值越低），其幸福感分數越高。由於情緒偵測能力向來是情緒商數（emotional intelligence, EI）的指標之一（Fischer et al., 2018），所以我們推論上述結果可能和情緒商數在幸福感中所扮演的角色有關。事實上過去研究指出高情商的個體通常較注重健康（Wickham et al., 2020）、擅於應付壓力（Slaski & Cartwright, 2002）、易於融入社會網絡（Zeidner & Olnick-Shemesh, 2010）、較少成癮等不良行為（Butler et al., 2020），並因此具有較高的幸福感（Zeidner et al., 2012）。我們期望在未來的研究中，透過直接檢驗情緒臉孔偵測能力與情緒商數之間的關聯以驗證上述的推論。

然而，值得注意的是持相悖結果的文獻也不在少數。例如 Yu 和 Li（2012）的研究指出，低水平幸福感者對於恐懼相關刺激更為敏感。此不一致性可能來自於行為典範以及使用情緒種類上的差異。由於幸福感所涉及之變項繁多，單一或少數因子是否真能客觀測量幸福感指數仍未可知，故未來需進一步檢測認知行為典範是否有更高的穩定度（是否較不易受到環境等外在因子的影響而出現偏誤）與信度（重複施測結果的一致性）。此外在過去幸福感研究中，某些變項有時既是幸福感研究中的自變項（例如情緒可以改變幸福感），有時又是依變項（以情緒變化來量測幸福感），再加上上述實驗中所得到的相關結果並不足以進行因果推論，期望未來的實驗可以納入更多的其他因子進行幸福感的預測，同時透過因果分析建立完善的模型。整體來說，認知行為典範是否比傳統量測方式更精準的量化幸福感，還有其潛在之應用價值（取代或是輔助傳統主觀報告）仍有待未來的進一步檢驗。

除了情緒偵測能力外，我們也奠基在情緒側化

圖 4
雙穩動態知覺與幸福感之淨相關結果



註：淨相關結果。結果顯示：當控制歸屬需求、復原能力以及憂鬱程度，由情境一所測得之雙邊比例（AR_v）分別和獨立 (a)、個人成長 (b) 和幸福感量表總分 (c) 呈正相關。圖示中，橫軸縱軸為問卷分數，縱軸皆為 AR_v 的數值。

的現象上，探討雙腦連結與幸福感指數的關聯。初步結果顯示，兩側半腦連結度越高者，整體而言具有較高的幸福感。此結果和過去文獻的結果一致。例如 Shahabi 和 Moghimi（2016）利用腦電波儀分析連結網絡（connectivity pattern），發現前額葉雙側連結程度和情緒激發程度成正相關。神經結構的分析研究也指出，雙腦間白質連結程度和情緒理解以及情緒管理呈正相關（Pisner et al., 2017）。值得注意的是，關於腦側化的起源及其解釋仍未有定論：部分研究指出腦側化的形成源自於單側功能不足，故著重使用對側腦；另一部分研究則指出腦側化源自單側腦先天優勢（Aboitiz et al., 2003）。爲釐清情緒歷程與幸福感指數的關聯，未來研究應進一步探討情緒側化與幸福感之因果關係。

此外，幸福感與相關概念之定義亦需要深入釐清以及相互比較，例如 Davidson（1998）指出情緒風格和「從負向情緒中恢復正常的能力」以及「維持正向情緒的能力」息息相關。其中，「從負向情緒中恢復正常的能力」即爲復原力（resilience）：泛指個體在面對逆境、創傷、悲劇、威脅、或重大壓力來源（例如家庭和人際關係問題、嚴重的健康問題或工作場所和財務壓力源）時的適應過程。雖然此概念涵蓋於我們近期的研究中，然而未來研究在探討相關議題時，除了幸福感指數外，相關概念之量測如復原力、歸屬感、樂觀、甚至是自我（簡晉龍等人，2009）等皆應同時納入考量。

最後，主觀報告的幸福感和客觀測量的幸福感程度是否隸屬同一概念仍有待商榷。例如，針對認知靈活性，近期由 Howlett 等人（2021）所發表的文章指出：由問卷（例如：認知靈活性量表，Cognitive Flexibility Scale ）所測得之結果與由行爲典範（例如：叫色測驗 Stroop Test、威斯康辛卡片分類測驗 Wisconsin Card Sorting Test 等）所測得之結果並不完全一致。故即使本研究透過相關分析，初步發現與幸福感相關之知覺關聯（perceptual correlates），未來仍須有更多的研究綜合上述之潛在混淆因子，進一步去探討由「自陳式」量表所測量以及由「行爲典範」所測量之幸福感的關聯。

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Objective Measurements of Well-being

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The study of subjective well-being has traditionally relied on psychological scales and correlation analyses. In this research, we introduce two perceptual tasks to investigate potential components that may impact subjective well-being: emotional detection and emotion lateralization. The first experiment utilized the discontinuous flash suppression paradigm to explore the relationship between unconscious emotion detection and well-being. Our results indicate that women with a greater capacity for detecting unconscious emotions are more likely to have positive emotions, stronger relationships, and higher levels of well-being than men. The second experiment, using the bi-stable paradigm, investigated the relationship between emotional lateralization and well-being. Our findings revealed that individuals with greater inter-hemispheric connections coped better with stress, had closer positive relationships, greater personal growth, and overall higher levels of well-being. This research attempts to identify "perceptual correlates" of well-being. To assess subjective well-being objectively and without bias, the relevant results will be further developed into a stable behavioral measurement.

Keyword: *behavior measurement, emotion, experimental paradigm, well-being*

Extended Abstract

Contemporary discussion of well-being can be broadly categorized into subjective or objective approaches to well-being based on the method used to measure happiness. Subjective measures of well-being emphasize personal experience and a sense of achievement, in which the individual's subjective judgment determines the level of well-being. Objective measures of well-being, in contrast, define well-being in terms of quality-of-life indicators such as material resources (income, food, and housing) and social attributes (education, health, political voice, social networks, and connections) (Western & Tomaszewski, 2016). Overall, subjective measures of well-being typically examine various related factors through correlation analysis, whereas objective measures focus more on theoretical construction and aim to determine which indicators should be included in the well-being model.

Physiological Experiments and Bell-being

Research on well-being has been criticized for over-reliance on self-reports, which are potentially biased. Researchers in the field of well-being science have therefore attempted to measure well-being using brain and physiological responses in addition to self-report scales. Because a wide range of cognitive processes influence well-being, most studies have adopted a reductionist approach that reduces well-being to specific cognitive functions (e.g., emotion, anxiety, depression, and rewards). With this strategy, researchers have developed various tasks to measure physical responses to well-being objectively, thereby minimizing the personal bias associated with self-reports that may influence the findings. Among the various cognitive functions, emotion is one of the most influential factors affecting well-being.

More recently, the incorporation of functional magnetic resonance imaging (fMRI) with various emotional tasks has demonstrated that emotional processing is closely associated with well-being (see

Houben et al., 2015, for a review). For instance, in a study by van Reekum et al. (2007), participants were instructed to make emotional judgments (i.e., negative or neutral) while undergoing fMRI. Following the scan, the participants were asked to complete a self-report questionnaire regarding personal well-being using the psychological well-being scale (PWB). Their results indicated that faster judgment of negative information was associated with increased activation of the bilateral amygdala. Additionally, people who evaluated negative information more slowly than neutral information reported higher PWB. Furthermore, higher PWB was strongly associated with greater activity in the ventral anterior cingulate cortex when negative information was compared with neutral information. Based on these findings, individuals with a higher degree of well-being seem more likely to use the ventral anterior cingulate cortex to cope with negative stimuli.

Additionally, Cunningham and Kirkland (2013) found that people with high levels of well-being displayed enhanced activation of the amygdala in response to positive stimuli. Furthermore, activation of the amygdala has been positively correlated with levels of cortisol, a type of stress hormone (Urry et al., 2006). Using the facial emotion processing task, a study by Ren et al. (2019) also found that while observing negative stimuli, activations of the right cingulate cortex, left medial temporal gyrus, and left angular gyrus were positively associated with self-reported well-being scores. Thus, the greater the activation of the above-mentioned brain regions, the greater the level of happiness. According to these results, people with high levels of well-being may be better at reducing the negative effects of negative stimuli through attention shifting or behavioral inhibition via the association between these aforementioned regions and other cognitive functions.

In addition to intensity, the persistence of the brain response is a critical indicator. In most prior studies, the persistence of responses was measured by an emotion regulation task, during which participants were required to perform emotional regulation (such as maintaining attention and reinforcing or suppressing current emotions) in response to the negative emotional pictures presented to them. The relevant studies found that individuals with higher self-rating scores for well-being showed stronger and longer-lasting responses in the ventral striatum when performing an emotion regulation task (Heller et al., 2013). The activation length of the left amygdala has also been positively correlated with the number of positive and negative emotions (Puccetti et al., 2021). This may even predict the degree of neuroticism of the individual (Schuyler et al., 2014). Moreover, a study by Jo et al., (2019) using not only emotional images but the comparison of neutral images (e.g., images of meditation and day walks), interpersonal images (e.g., family, friendship, and partner-related images), and personal activity images (e.g., images of relaxation, rewards, and achievements), indicated significant overlap between the neural circuits involved in well-being and the brain areas associated with reward processing.

Overall, experiencing relatively high levels of positive emotions and relatively low levels of negative emotions (within a certain range) is a key component of mental health. Furthermore, the neural mechanisms related to well-being may exist in deep brain regions, including the cingulate cortex, amygdala, striatum, and several cortical areas such as the medial temporal gyrus, angular gyrus, and prefrontal cortex.

The Association between Emotional Detection and Bell-being

Emotions may be perceived in both a top-down and a bottom-up manner. From the perspective of top-down processing, emotional regulation has been shown to be critical to the level of well-being. As for bottom-up processing, Yu and Li (2012) demonstrated that positive primes elicited comparable amplitudes of LPP in both high- and low-level well-being groups using the emotion-priming paradigm. Negative primes, however, elicited a stronger response in the low well-being group than in the high well-being group. Overall, these results suggest that individuals with lower well-being are more sensitive to negative stimuli (Yu & Li, 2012). However, although the emotional priming effect has been associated with well-being, no prior studies have directly examined the relationship between unconscious emotional detection and well-being.

A recent study by Feng et al. (2022a, submitted) using the d-CFS paradigm demonstrated that the detection of invisible facial expressions may be associated with well-being. Furthermore, the association was gender-specific when the researchers controlled for other psychological states such as resilience and the need to belong. More specifically, the study showed that compared with men, women with a greater capacity for detecting unconscious emotions were more likely to have positive emotions, strong relationships with others, and a higher level of well-being.

The Association between Emotional Lateralization and Well-being

In addition to the ability to detect emotions, we believe that the lateralization found with emotional perception may also relate to well-being. In fact, the lateralization of emotional processing has been used to predict responses to emotional stimuli and well-being (Dalton et al., 2002; Hsieh et al., 1999; Jackson & Burgess, 2000; Ochsner et al., 2002). Furthermore, the degree of information integration between the two hemispheres has been linked to the ability to detect facial emotions at an early stage (Frässle et al., 2016a). Thus, in a prior study, we explored whether connectivity between the two hemispheres is related to the level of well-being (Feng et al. 2022b, submitted). Our results showed that people with greater connections between the two hemispheres coped better with stress and had closer positive relationships, greater personal growth, and higher overall levels of well-being.

General Discussion

In summary, the aim of this article is to review cognitive experiments on well-being and explore behavioral paradigms that may objectively quantify levels of well-being. To avoid potential confounding variables, we use low-level visual perception paradigms as an auxiliary measure of well-being. The preliminary results show that the participants who were better at detecting emotional faces (low-contrast visibility for perceiving emotional faces) scored higher on the well-being scale.

This result may be related to the role of emotional intelligence in well-being, given that the ability to detect emotion has always been considered an indicator of emotional intelligence (Emotional Intelligence, EI, Fischer et al., 2018). In fact, previous studies have demonstrated that individuals who possess high levels of emotional intelligence are healthier (Wickham et al., 2020), better able to handle stress (Slaski & Cartwright, 2002), more comfortable integrating into social networks (Zeidner & Olnick-Shemesh, 2010), and less susceptible to addiction and other harmful behaviors (Butler et al., 2020), and are therefore have higher well-being (Zeidner et al., 2012). More research is needed to examine the relationship between emotional intelligence and the ability to detect emotional information without being aware of it.

Our results, however, conflict with some previous findings. For instance, Yu and Li (2012) found that people with low levels of well-being were more sensitive to fear-related stimuli. This inconsistency may reflect differences in the paradigms used. Furthermore, well-being is influenced by several factors, and it is unclear whether a single or a limited number of factors can be used to objectively measure well-being. In addition, the results obtained in the abovementioned experiments cannot be used to infer causality. More factors should be included in future experiments to predict well-being and develop a causal model.

Apart from emotional detection, based on the phenomenon of emotional lateralization, we further explored the relationship between hemispheric connectivity and levels of well-being. Our preliminary results show that people with higher connectivity between the two sides of the brain have higher levels of well-being in general. This result is consistent with previous findings. For instance, a study by Shahabi and Moghimi (2016) using EEG demonstrated a positive correlation between bilateral connectivity in the prefrontal cortex and emotional arousal. Additionally, the connection between the two hemispheres has been positively correlated with emotional understanding and emotional management

(Pisner et al., 2017). However, the origin and explanation of brain lateralization remain obscure. According to some studies, lateralization of the brain may result from unilateral dysfunction, in which the contralateral brain becomes dominant. In contrast, other studies suggest that lateralization results from the innate dominance of the unilateral brain (Aboitiz et al., 2003). To clarify the relationship between emotion and well-being, more research is needed on the causal relationship between emotional lateralization and well-being.

Finally, although there has been a call for the objective examination of well-being, it remains unclear whether well-being measured with self-report scales and that measured with experimental tasks are the same. Further research is required to explore the relationship between well-being measured by self-report scales and that measured by behavioral/cognitive paradigms.

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