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La reconnaissance d'émotions faciales et musicales dans le processus de vieillissement normal

par Alexina Croteau

Département de Psychologie
Faculté des Arts et des Sciences

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Résumé

Un nombre grandissant d'études rapportent des différences liées à l'âge dans la capacité à reconnaître les émotions. Leurs résultats ne sont cependant pas unanimes quant à l'ampleur des changements, ainsi qu'aux catégories d'émotion ou aux médiums évocateurs affectés par ces changements. L'objectif de la présente étude est d'explorer l'effet du vieillissement normal sur la capacité à reconnaître les émotions exprimées par le visage et par la musique. Pour atteindre cet objectif, un groupe de 34 aînés, âgés entre 65 et 87 ans et un groupe de 31 adultes âgés entre 18 et 50 ans ont complété deux tâches évaluant la reconnaissance des émotions faciales et musicales. La tâche de catégorisation d'expressions faciales comprend des visages exprimant la joie, la tristesse, la peur, la colère et la surprise. La tâche de catégorisation des émotions exprimées par des extraits musicaux inclut la joie, la tristesse et la peur. Les résultats indiquent des différences entre les groupes d'âge. Les aînés reconnaissent moins bien que les adultes toutes les émotions faciales, mais seulement la tristesse et la peur exprimées par la musique. Les deux groupes catégorisent de manière similaire la joie exprimée par la musique. Enfin, pour les deux groupes d'âge, la peur est l'émotion la moins bien reconnue et ce peu importe le médium. Puisque le vieillissement normal entraîne plusieurs changements physiologiques et psychologiques, les résultats pourraient être partiellement expliqués par les théories socioémotionnelle et neurologique.

Mots-clés : vieillissement normal, reconnaissance émotionnelle, émotion faciale, émotion musicale, biais positif

Abstract

A growing number of studies report differences between older and younger adults in emotion recognition. However, there are still conflicting results regarding the extent of the changes and how they may vary depending on the expressed emotion and the medium used. The present study aims at supplementing our understanding of the global phenomenon by focusing on cognitively normal older adults' capacity to recognize both facial and musical emotions. A group of 34 older adults, aged between 65 and 87, and a control group of 31 younger adults, aged between 18 and 50, completed two separate tasks evaluating emotion recognition of faces and music. The facial emotion categorization task includes faces expressing happiness, sadness, fear, anger and surprise. The musical emotion categorization task includes music excerpts expressing happiness, sadness and fear. Results indicate differences in emotion recognition between age groups. Indeed, older adults are less accurate than younger adults in the recognition of all five emotions as expressed by faces, but only of fear and sadness as expressed by musical excerpts. Both groups categorize happiness, as expressed by music, in a similar manner. Lastly, for both groups, fear is the less accurately recognized emotion, whether it is expressed by faces or music. In this regard, as normal aging involves many physiological and psychological changes that may be related to those observations, it has been proposed that the results may be partially explained by both the socioemotional and the neurological theories.

Keywords: normal aging, emotion recognition, facial emotion, musical emotion, positivity effect

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BRAMS	Brain, Music and Sound Research
CIUSSS	Centre Intégré Universitaire de Santé et de Services Sociaux
CHUS	Centre Hospitalier Universitaire de Sherbrooke
DRS	Dementia Rating Scale
GDS	Geriatric Depression Scale
GDS-S	Geriatric Depression Scale – Short version
MMS	Mini-Mental State
MIDI	Musical Instrument Digital Interface

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Introduction

En juillet 2015, 18.2% de la populeuse génération *baby boomers* était âgée de 65 ans et plus (Statistics Canada, 2015). À ce moment, le groupe des personnes âgées (65 ans et plus) représentait 16.1% de la population du Canada, dépassant par son nombre le groupe des enfants (0 à 14 ans) pour la première fois dans l'histoire canadienne (Statistics Canada, 2015). D'ici 2024, les prédictions démographiques présagent qu'approximativement un Canadien sur cinq sera âgé de 65 ans et plus (Statistics Canada, 2015). Comme le vieillissement normal est associé à plusieurs changements, il est essentiel d'explorer et de mieux comprendre ceux-ci, en particulier lorsque ces derniers sont susceptibles d'affecter négativement la population vieillissante. Par exemple, un nombre grandissant d'études rapportent que les personnes âgées reconnaissent moins bien certaines émotions que les adultes (pour une méta-analyse, voir Ruffman, Henry, Livingstone, & Phillips, 2008). Or, la capacité à reconnaître les émotions favorise un fonctionnement social plus adéquat et est associée à un plus grand bien-être (Keltner & Kring, 1998). À l'inverse, un dysfonctionnement de cette capacité est associé à une réduction du bien-être relationnel et à une augmentation des symptômes dépressifs (Carton, Kessler, & Pape, 1999). De surcroît, le dysfonctionnement de la reconnaissance des émotions peut mener à des difficultés à discriminer les comportements inappropriés de ceux qui sont appropriés (Halberstadt, Ruffman, Murray, Taumoepeau, & Ryan, 2011). Dans cette étude, un groupe d'adultes (âgés entre 60 et 85 ans) et un groupe de jeunes adultes (âgés entre 18 et 35 ans) ont visionné des extraits vidéo et devaient juger du caractère approprié ou non des comportements sociaux (perception de *faux pas*). Dans la moitié de ces clips, le personnage, un patron, agit de manière inappropriée. Par exemple, il annonce sa propre promotion tout en informant les

employés de leur possible mise à pied. Une régression multiple indique un effet de l'âge sur la perception de *faux pas*. En effet, les résultats tendent à soutenir que les aînés reconnaissent significativement moins bien les comportements inappropriés que les jeunes adultes. Toutefois, lorsque la capacité à reconnaître les émotions est ajoutée au modèle, l'effet de l'âge devient non-significatif. Alors, la reconnaissance émotionnelle prédit fortement et positivement la capacité à reconnaître les comportements sociaux inappropriés (Halberstadt et al., 2011). Il est donc nécessaire d'approfondir la compréhension de l'effet du vieillissement normal sur la reconnaissance émotionnelle, afin de limiter la détresse subséquente pouvant potentiellement affecter un grand pourcentage de la population. L'objectif global de la présente étude est donc d'explorer l'effet du vieillissement normal sur la reconnaissance d'émotions, en particulier les émotions exprimées par le visage et par la musique.

Effet du vieillissement normal sur la reconnaissance des émotions

L'effet du vieillissement normal sur la reconnaissance émotionnelle a été principalement étudié par le biais du médium du visage et plus particulièrement avec les expressions faciales d'émotions de base (Ruffman et al., 2008). Les émotions dites « de base » incluent la peur, la tristesse, la colère, la joie, la surprise et le dégoût. Les célèbres travaux de recherche d'Ekman ont montré que ces émotions de base seraient universellement reconnues lorsque représentées par des photographies de visages (Ekman, 1970, 2017; Ekman & Friesen, 1971; Ekman, Friesen, & Ellsworth, 1972). Alors que les expressions faciales d'émotions de base seraient généralement bien reconnues par différentes cultures, un nombre grandissant d'études indique qu'il existe des disparités dans cette habileté entre certains groupes d'âge (voir Ruffman et al., 2008, pour une méta-analyse), et ce pour diverses catégories d'émotion. En effet, de nombreuses études récentes ont démontré que, comparativement aux jeunes adultes, les personnes âgées reconnaissent

significativement moins bien la peur (Beer, Smarr, Fisk, & Rogers, 2015; Circelli, Clark, & Cronin-Golomb, 2013; Horning, Cornwell, & Davis, 2012; Orgeta & Phillips, 2008; Sutcliffe, Rendell, Henry, Bailey, & Ruffman, 2017; Suzuki & Akiyama, 2013; West et al., 2012; Williams et al., 2006; Williams et al., 2009), la tristesse (Beer et al., 2015; Chaby, Luherne-du Boullay, Chetouani, & Plaza, 2015; Horning et al., 2012; Ma, Li, Niu, Yu, & Yang, 2013; Orgeta & Phillips, 2008; Ruffman, Ng, & Jenkin, 2009; Sutcliffe et al., 2017; Suzuki & Akiyama, 2013; West et al., 2012) et la colère (Beer et al., 2015; Chaby et al., 2015; Hot et al., 2013; Ruffman et al., 2009; Sutcliffe et al., 2017; Suzuki & Akiyama, 2013; West et al., 2012; Williams et al., 2009). Quelques-unes de ces études récentes ont également rapporté une diminution avec l'âge de la reconnaissance de la joie (Beer et al., 2015; Horning et al., 2012; Suzuki & Akiyama, 2013) et de la surprise (Suzuki & Akiyama, 2013). L'ensemble de ces résultats sont compatibles avec la méta-analyse de Ruffman et al. (2008) qui inclut un total de 705 personnes âgées (dont la moyenne d'âge des groupes étudiés varie de 65.1 à 76.9 ans), ainsi que de 962 jeunes adultes (dont la moyenne d'âge des groupes répertoriés varie de 19.2 à 29.9 ans). Cette méta-analyse a conclu que les aînés reconnaissent globalement moins bien les émotions faciales que les autres adultes. Plus précisément, ils ont trouvé que la reconnaissance de la colère, de la tristesse et de la peur diminue substantiellement et significativement lors du vieillissement normal, tandis que la reconnaissance de la joie et de la surprise diminue significativement elles aussi, mais dans une moindre mesure que celles de la tristesse, de la colère et de la peur. Une autre méta-analyse récente a confirmé la présence d'un biais positif chez les personnes âgées (Reed, Chan, & Mikels, 2014). Ce biais attentionnel et mnésique favoriserait les stimuli ayant une valence émotionnelle positive plutôt que négative (p. ex., regarder plus les expressions faciales exprimant la joie que celles exprimant une émotion négative, comme la tristesse; Carstensen &

Mikels, 2005; Mather & Carstensen, 2005). La présence d'un biais positif lié au vieillissement pourrait potentiellement être compatible avec les résultats de méta-analyse de Ruffman et ses collaborateurs (2008), puisque cette dernière a conclu que les émotions faciales à valence relativement positive (la joie et la surprise) sont moins affectées par l'âge que les émotions à valence négative (la tristesse, la colère et la peur).

En parallèle, bien que la musique soit un médium évocateur d'émotion puissant et efficace (Peretz, 2010; Vieillard et al., 2008), peu d'études ont exploré l'effet du vieillissement normal sur ce celle-ci. L'étude d'Allen et Brosgole (1993) a rapporté que les aînés reconnaissent moins bien que les jeunes adultes les émotions (la joie, la tristesse et la colère) exprimées par la musique. Plus tard, une autre étude a rapporté que les aînés (65 à 83 ans) commettent significativement plus d'erreurs lors de la reconnaissance de la joie, de la tristesse et de la colère que les jeunes adultes (18 à 43 ans ; Brosgole & Weisman, 1995). Ces deux études ont utilisé les mêmes extraits musicaux, tirés des répertoires de musique populaire jazz ou classique, sans toutefois préciser les paramètres musicaux de ces extraits. Pourtant, certaines composantes musicales (p. ex., le tempo et le mode) ont été associées à des catégories d'émotions spécifiques (Vieillard et al., 2008). Par exemple, il a été démontré que les musiques jugées joyeuses par les auditeurs ont comme caractéristiques communes un tempo relativement rapide et un mode majeur (Vieillard et al., 2008). Ensuite, l'étude de Laukka et Juslin (2007) a elle aussi rapporté une diminution avec l'âge de la reconnaissance de la peur et de la tristesse, mais la joie et la colère ont été reconnues de manière similaire par les jeunes et les âgés. Contrairement aux études précédentes, les études subséquentes de Lima et Castro (Castro & Lima, 2014; Lima & Castro, 2011) ont utilisé des extraits musicaux spécifiquement composés pour la recherche sur les émotions musicales (composés et validés par Vieillard et al., 2008). Ce matériel musical

comporte donc l'avantage d'être inconnu des participants, sachant que les théories des émotions musicales stipulent que la mémoire peut affecter la manière dont les émotions sont reconnues (voir Juslin & Västfjäll, 2008). De plus, les extraits musicaux validés de Vieillard et ses collaborateurs (2008) ont été composés selon des paramètres musicaux connus pour être associés à chacune des catégories d'émotion. Plus précisément, les extraits exprimant la joie ont été composés en mode majeur sur un tempo rapide, ceux exprimant la quiétude en mode majeur sur un tempo lent, ceux exprimant la tristesse en mode mineur sur un tempo lent et ceux exprimant la peur ont été composés avec des modes changeant sur un tempo intermédiaire et variable (Vieillard et al., 2008). Avec l'utilisation de ces extraits musicaux, Castro et Lima (Castro & Lima, 2014; Lima & Castro, 2011) ont démontré que de la reconnaissance d'émotions à valence négative (la tristesse et la peur) est inférieure chez les aînés en comparaison aux plus jeunes, alors que la reconnaissance d'émotions à valence positive (la joie et la quiétude) semblait préservée. Toutefois, il y a une autre étude récente (Sutcliffe et al., 2017) ayant utilisé une banque d'extraits variés dont certains stimuli tirés de l'étude de Vieillard et ses collaborateurs (2008) et certains extraits musicaux de style *pop/rock* provenant de chansons existantes, mais peu connues. Les résultats ont indiqué que toutes les émotions musicales (la joie, la quiétude, la tristesse, la peur et la colère) étaient moins bien reconnues par les personnes âgées que les jeunes adultes.

En somme, la plupart des études indiquent des changements liés à l'âge dans la capacité à reconnaître les émotions musicales. Parmi ces études, les résultats sont cependant variables quant aux catégories d'émotions affectées, certaines études suggérant une atteinte plus globale et d'autres pouvant suggérer une atteinte plus spécifique des émotions (p. ex., celles à valence

négative). Deux théories ont souvent été présentées pour expliquer ce phénomène, soit la théorie socioémotionnelle et la théorie neurologique.

Biais positif et théorie socioémotionnelle

Il a été proposé qu'il existerait un biais positif attentionnel et mnésique chez les personnes âgées qui favoriserait les informations positives plutôt que négatives (Carstensen & Mikels, 2005; Mather & Carstensen, 2005). Conformément à cette théorie, il a été trouvé, dans certains cas, que la joie exprimée par le visage est mieux reconnue par les aînés que par les jeunes adultes (Williams et al., 2006). Par ailleurs, une méta-analyse explorant l'existence potentielle d'un biais positif lié à l'âge a confirmé un léger, mais significatif, biais positif attentionnel et mnésique chez les personnes âgées (Reed, Chan, & Mikels, 2014). Elle n'incluait cependant aucune étude portant sur les émotions musicales.

Afin d'expliquer ce biais, la théorie socioémotionnelle propose que la perception du temps qui s'écoule module les motivations des individus (Carstensen, 2006; Carstensen, Isaacowitz, & Charles, 1999), ce qui expliquerait certains changements liés au vieillissement (Carstensen, 1993; Liao & Carstensen, 2018). Concrètement, la théorie stipule qu'en vieillissant, la durée de sa propre vie est perçue comme de plus en plus limitée, ce qui pousse alors les personnes âgées à prioriser des objectifs différents de leurs homologues plus jeunes. Par exemple, alors que les adultes ont plus tendance à privilégier des objectifs orientés vers l'acquisition de connaissance, les aînés tendent, quant à eux, à privilégier des objectifs porteurs d'une valeur émotionnelle (p. ex., maintenir des émotions positives, préserver des relations interpersonnelles étroites et trouver une direction émotionnellement significative à leur vie) (Carstensen, Fung, & Charles, 2003; Carstensen et al., 1999; Fung & Carstensen, 2003). En sommes, il est proposé que les aînés portent plus d'attention aux stimuli positifs que négatifs

(Charles, Mather, & Carstensen, 2003; Reed & Carstensen, 2012; Reed et al., 2014), dans le but de régulariser leurs émotions et de maintenir des affects positifs, ainsi que des situations interpersonnelles positives dans leurs vies (Carstensen et al., 2003; Liao & Carstensen, 2018; Löckenhoff & Carstensen, 2004; Mather & Carstensen, 2005). Les changements liés à l'âge dans la reconnaissance émotionnelle proviendraient donc de changements motivationnels.

Théorie neurologique

Pour sa part, la théorie neurologique propose que les différences liées à l'âge dans la reconnaissance émotionnelle soient plutôt dues à des changements neuronaux normaux liés au vieillissement. Elle est construite sur la prémisse que différentes régions du cerveau sont plus impliquées que d'autres dans la reconnaissance de différentes émotions et que ces régions ne sont pas toutes atteintes de la même façon et au même rythme par l'âge (voir Ruffman et al., 2008, pour un commentaire). Ceci pourrait donc potentiellement expliquer en partie pourquoi certaines études ont trouvé que le vieillissement affecte différemment la reconnaissance de certaines émotions plutôt que d'autres (Castro & Lima, 2014; Circelli, et al., 2013; Lima & Castro, 2011; West et al., 2012; Williams et al., 2006). Plusieurs études neuropsychologiques ont exploré le lien entre le cerveau et la reconnaissance des émotions. Par exemple, plusieurs ont démontré que la reconnaissance de la peur est principalement liée à l'amygdale, pour les stimuli faciaux (Adolphs, 2008; Adolphs, Tranel, Damasio, & Damasio, 1994; Adolphs et al., 1999; Davis & Whalen, 2001) et musicaux (Gosselin, Peretz, Hasboun, Baulac, & Samson, 2011; Gosselin, Peretz, Johnsen, & Adolphs, 2007; Gosselin et al., 2005). La reconnaissance de la tristesse a elle aussi été associée à l'amygdale (Blair, Morris, Frith, Perrett, & Dolan 1999). Toutefois, elle a aussi été associée au cortex cingulaire antérieur (Blair et al., 1999), dont le volume (Ohnishi, Matsuda, Tabira, Asada, & Uno, 2001) et le métabolisme déclinent avec l'âge

(Petit-Taboué, Landeau, Desson, Desgranges, & Baron, 1998). La reconnaissance de la colère exprimée par le visage a été associée, entre autres, à l'amygdale (Mattavelli et al., 2014; Ziaei et al., 2016), au cortex orbito-frontal (Blair et al., 1999; Murphy, Nimmo-Smith, & Lawrence, 2003), ainsi qu'au cortex cingulaire antérieur (Jehna et al., 2011; Ziaei et al., 2016). La reconnaissance de la surprise et de la joie a aussi été associée, entre autres, à l'amygdale (Breiter et al., 1996; Zhao, Zhao, Zhang, Cui, & Fu, 2017).

En sommes, bien que d'autres régions du cerveau se spécialisent dans la reconnaissance de différentes émotions, l'amygdale est associée à la reconnaissance de la joie, la tristesse, la peur, la colère et la surprise (Blair et al., 1999; Breiter et al., 1996; Davis & Whalen, 2001; Gosselin et al., 2011; Mattavelli et al., 2014; Zhao et al., 2017; Ziaei et al., 2016). Comme l'amygdale s'atrophie de manière linéaire avec l'âge (Allen, Bruss, Brown, & Damasio, 2005), il est possible qu'elle soit au moins en partie responsable des changements liés à l'âge dans la reconnaissance émotionnelle. Toutefois, des études tendent à suggérer que l'amygdale est plus impliquée dans la reconnaissance de la peur que de la joie (Mattavelli et al., 2014; Morris et al., 1996) et plus impliquée dans la reconnaissance de la tristesse que de la joie (Adolphs & Tranel, 2004). En fait, des lésions à l'amygdale affecteraient spécialement la reconnaissance de la peur exprimée par le visage ou la musique (Gosselin et al., 2011), indiquant que la reconnaissance de la peur serait probablement la plus affectée par une atrophie liée à l'âge de l'amygdale. De plus, la reconnaissance de la joie semble impliquer plus de régions cérébrales que celle de la colère, de la peur ou de la tristesse, ce qui pourrait potentiellement expliquer sa relative préservation avec l'âge (voir Ruffman et al., 2008).

En résumé, la théorie socioémotionnelle se base sur la prémisse selon laquelle il existerait un biais positif attentionnel et mnésique chez les personnes âgées (Carstensen &

Mikels, 2005; Mather & Carstensen, 2005). Cette dernière propose que la perception du temps qui s'écoule pousse les individus vieillissants à favoriser les informations positives plutôt que négatives (Carstensen, 2006; Carstensen et al., 1999; Carstensen & Mikels, 2005; Mather & Carstensen, 2005), afin de régulariser leurs émotions, ainsi que de maintenir des affects positifs et des relations interpersonnelles positives (Carstensen et al., 2003; Liao & Carstensen, 2018; Löckenhoff & Carstensen, 2004; Mather & Carstensen, 2005). La théorie neurologique postule que les écarts liés à l'âge dans la reconnaissance émotionnelle seraient plutôt dus au déclin normal de régions cérébrales liées à la reconnaissance émotionnelle (Ruffman et al., 2008). Ces théories sont possiblement compatibles avec certains résultats observés dans la littérature, mais il existe des disparités entre les résultats de plusieurs études.

Facteurs influents

Il est possible que les divergences de résultats dans la littérature soient en partie imputables à divers facteurs individuels qui ont pu affecter la performance des participants. Tout d'abord, l'état émotionnel d'un individu au moment de sa participation pourrait avoir un impact sur ses perceptions (Voelkle, Ebner, Lindenberger, & Riediger, 2014). À l'extrême, la présence de symptômes dépressifs a été associée à une exacerbation de la sensibilité d'un individu aux stimuli émotionnels à valence négative, tant faciaux que musicaux (Orgeta, 2014; Naranjo et al., 2011; Punkanen, Eerola, & Erkkilä, 2011). La présence de symptômes dépressifs est donc un facteur important, puisqu'elle peut potentiellement se traduire par une augmentation de la reconnaissance d'émotions négatives, au détriment des émotions positives. Nonobstant ce phénomène, certaines études explorant la reconnaissance d'émotions faciales ont choisi de ne pas contrôler pour la présence de symptômes dépressifs chez leurs participants (Beer et al., 2015; Calder et al., 2003; Horning et al., 2012; Sutcliffe et al., 2017). Toutefois, d'autres études l'ont

fait (Chaby et al., 2015; Circelli et al., 2013; Suzuki & Akiyama, 2013) et ces divergences dans les facteurs considérés pourraient expliquer en partie les disparités observées. Par exemple, pour les visages, Horning et ses collaborateurs (2012), qui n'ont pas contrôlé pour les symptômes dépressifs, ont rapporté que les aînés reconnaissent moins bien la joie que les adultes. À l'inverse, Circelli et ses collaborateurs (2013), qui ont contrôlé pour les symptômes dépressifs, ont plutôt trouvé que les aînés et les adultes reconnaissent de manière similaire la joie. Quant à la musique, à notre connaissance, aucune étude explorant l'effet du vieillissement normal sur la reconnaissance d'émotions musicales n'a contrôlé pour la présence de symptômes dépressifs chez les participants.

Un autre facteur important pouvant influencer les résultats sur l'effet de l'âge sur la reconnaissance des émotions est la culture des participants. Pour les visages, bien que les émotions de base soient reconnues de manière universelle, les mécanismes menant à la reconnaissance diffèrent entre les cultures (Biehl et al., 1997; Blais, Jack, Scheepers, Fiset, & Caldara, 2008; Jack, Blais, Scheepers, Schyns, & Caldara, 2009). Pour la musique, Laukka, Eerola, Thingujam, Yamasaki et Beller (2013) ont rapporté que l'auditeur tend à reconnaître plus aisément les signaux émotionnels exprimés par une musique de sa propre culture, ce dernier ayant été implicitement exposé aux structures musicales y correspondant. De surcroît, un autre facteur influençant la reconnaissance d'émotions musicales est l'expertise musicale. En effet, il a été trouvé que les musiciens reconnaissent plus facilement les émotions exprimées par la musique que les non-musiciens (Castro & Lima, 2014; Hailstone et al., 2009; Sutcliffe et al., 2017). De plus, la présence de troubles cognitifs peut influencer la reconnaissance émotionnelle. De fait, plusieurs études ont rapporté que les personnes avec une démence de type Alzheimer ont de la difficulté à reconnaître certaines expressions faciales (Drapeau, Gosselin, Gagnon,

Peretz, & Lorrain, 2009; Gagnon, Gosselin, Provencher, & Bier, 2012), telles que la joie, la tristesse, la peur, la colère et la surprise (Henry et al., 2008). Cet effet n'a toutefois pas été trouvé pour la reconnaissance d'émotions musicales, laquelle ne semble pas être affectée chez les individus atteints de la démence de type Alzheimer (Drapeau et al., 2009).

La présence de telles différences individuelles est très souvent présente entre les études ayant exploré la reconnaissance des émotions faciales et musicales, ce qui renforce l'intérêt particulier du devis de recherche de la présente étude. En effet, l'exploration de deux médiums distincts (visage et musique), au sein d'un même groupe de participants, permettra de réduire l'influence des différences individuelles et donc, d'affirmer avec plus d'assurance si l'effet de l'âge sur la reconnaissance émotionnelle varie selon les médiums utilisés ou non. Par la suite, si l'âge affecte la reconnaissance d'émotions faciales et musicales différemment, il serait possible de postuler que ces changements soient potentiellement liés à des mécanismes sous-jacents au moins partiellement exclusifs à chaque modalité.

Objectifs

La présente étude vise donc à explorer le vieillissement normal de la reconnaissance des émotions. Plus spécifiquement, cette étude a pour objectif d'investiguer l'effet de l'âge sur la capacité à reconnaître des émotions de base exprimées par les visages (c.-à-d., la joie, la tristesse, la peur, la colère et la surprise) et par la musique (c.-à-d., la joie, la tristesse et la peur) au sein des mêmes groupes de participants. Les facteurs pris en considération seront la présence de symptômes dépressifs, ainsi que la culture, l'expertise musicale et le fonctionnement cognitif des participants.

Article

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Recognition of Facial and Musical Emotions in Aging

Alexina Croteau [1, 2, 3, 4], Gabriel Ducharme-Laliberté [1, 5], Lise Gagnon [6, 7], Sophie Matter [6, 7], Sébastien Paquette [1, 2, 3, 8], Stéphanie Paré [6, 7], & Nathalie Gosselin [1, 2, 3]

(1) Department of Psychology, University of Montreal, Montreal, Quebec, Canada

(2) International Laboratory for Brain, Music, and Sound Research (BRAMS), Montreal, Quebec, Canada

(3) Center for Research on Brain, Language and Music (CRBLM), Montreal, Quebec, Canada

(4) Department of Psychology, University of Sherbrooke, Sherbrooke, Quebec, Canada

(5) Centre de Recherche de l'Institut Universitaire de Gériatrie de Montréal (CRIUGM), Montreal, Quebec, Canada

(6) Department of Psychology, University of Sherbrooke, Sherbrooke, Quebec, Canada

(7) Centre de recherche sur le vieillissement, Sherbrooke, Quebec, Canada

(8) Department of Neurology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

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Abstract

Impairments in the capacity to recognize emotions are associated with reduced relationship well-being, as well as more severe symptoms of depression. Thus, as a growing number of studies report differences between the elderly and young to middle-aged adults in emotion recognition, it seems imperative to improve our understanding of these observations. The present study aims at supplementing our understanding of the global phenomenon by focusing on the capacity of cognitively normal elderly individuals to recognize both facial and musical emotions. A group of 34 elderly individuals, aged between 65 and 87, and a control group of 31 adults, aged between 18 and 50, had to complete two separate tasks. One aimed at categorizing emotions expressed by photographed faces (happiness, sadness, fear, anger and surprise), while the other aimed at categorizing emotions expressed by musical excerpts (happiness, sadness, fear). Results suggest that the effect of age on emotion recognition differed depending on the expressed emotion and the medium used. Indeed, the elderly subjects were less accurate than the control adults in the recognition of all five emotions as expressed by faces, but only of fear and sadness as expressed by musical excerpts. Meanwhile, happiness recognition seemed preserved. Furthermore, both groups were less accurate in the recognition of fear compared to any other emotion, whether they were presented with facial or musical stimuli. In this regard, as normal aging involves many physiological and psychological changes that may be related to these observations, results may be partially explained by both socioemotional and neurological theories.

As recent projections estimate that, by July 2024, roughly 1 out of 5 Canadians will be aged 65 years or older (Statistics Canada, 2015), it seems increasingly important to investigate natural changes associated with aging, seeing as they could potentially influence the well-being of a considerable number of individuals. Indeed, normal aging is associated with many changes, including some that may affect neurological or cognitive processes. For example, it has been reported that some of these changes could have an impact on the ability to recognize emotions, resulting in a lower capacity to recognize emotions expressed by faces, voices or even music (see Ruffman, Henry, Livingstone, & Phillips, 2008, for a review). Impairments in emotion recognition may lead to difficulty discriminating appropriate from inappropriate behaviours (Halberstadt, Ruffman, Murray, Taumoepeau, & Ryan, 2011). As a result, these impairments are also associated with reduced relationship well-being as well as greater depression symptoms among adults (Carton, Kessler, & Pape, 1999). It is thus crucial to study the scope of emotion recognition changes in different contexts to better understand the underlying mechanisms involved. The present study therefore aims at exploring the effect of age on both facial and musical emotion recognition, and whether that effect varies, depending on the emotion expressed or the medium used.

Researchers interested in emotion recognition have mainly focused on the face as an emotional medium. Although it was used through various methodologies (e.g., Beer, Smarr, Fisk, & Rogers, 2015; Silver & Bilker, 2015), Ekman and Friesen's (1976) Pictures of Facial Affect is commonly used as stimuli in such studies. It is a validated set of static black-and-white photographs of faces, depicting some of the basic emotions (happiness, sadness, fear, anger, surprise and disgust). During the experiments, participants are typically asked to categorize the emotion expressed by each stimulus, among a list of answers.

Overall, there are some discrepancies in the results of the various studies on facial emotion recognition in aging. Nevertheless, a significant age-related decrease in the recognition of fear is frequently reported (Beer et al., 2015; Calder et al., 2003; Circelli, Clark, & Cronin-Golomb, 2013; Horning, Cornwell, & Davis, 2012; Isaacowitz et al., 2007; Montagne, Kessels, De Haan, & Perrett, 2007; Orgeta & Phillips, 2008; Sullivan & Ruffman, 2004; Suzuki & Akiyama, 2013; West et al., 2012; Williams et al., 2009); the same is true for sadness (Beer et al., 2015; Calder et al., 2003; Chaby, Luherne-du Boullay, Chetouani, & Plaza, 2015; Horning et al., 2012; Ma, Li, Niu, Yu, & Yang, 2013; Montagne et al., 2007; Orgeta & Phillips, 2008; Phillips, MacLean, & Allen, 2002; Ruffman, Ng, & Jenkin, 2009; Sullivan & Ruffman, 2004; Suzuki & Akiyama, 2013; Suzuki, Hoshino, Shigemasu, & Kawamura, 2007; West et al., 2012) and anger (Beer et al., 2015; Calder et al., 2003; Chaby et al., 2015; Hot et al., 2013; Montagne et al., 2007; Orgeta & Phillips, 2008; Phillips et al., 2002; Ruffman et al., 2009; Sullivan & Ruffman, 2004; Suzuki & Akiyama, 2013; West et al., 2012; Williams et al., 2009). Some researchers also reported a significant decrease in the recognition of happiness (Beer et al., 2015; Horning et al., 2012; Montagne et al., 2007; Suzuki & Akiyama, 2013) and surprise (Suzuki & Akiyama, 2013).

Trying to integrate and summarize the different findings of previous studies, Ruffman et al.'s (2008) meta-analysis highlighted some significant patterns that emerged from the multiple studies. It revealed that the recognition of anger, sadness and fear are the most affected in aging, while the recognition of happiness and surprise are also affected, but substantially less than negatively-valenced emotions. These findings are congruent with Reed, Chan and Mikels' meta-analysis (2014) which supports a positivity effect among the elderly towards many stimuli, including facial. The positivity effect supposes that the elderly are characterized by a memory

and attentional bias favouring positive emotional information over negative (Carstensen, 2006; Carstensen, Fung, & Charles, 2003), which could explain why the recognition of relatively positively-valenced facial emotions (happiness and surprise) was not as affected as negatively-valenced ones (fear, sadness and anger).

Meanwhile, music is known to be a powerful, easily manipulated, and very effective medium of emotional evocation (Peretz, 2010; Vieillard et al., 2008). It allows emotions to be communicated through the auditory domain, much like speech prosody, which is globally defined as the auditory components of speech. Subsequently, several studies report that music communicates emotions through similar auditory cues as prosody (e.g. tempo and melody) (Coutinho & Dibben, 2013). Accordingly, some results suggest that, when presented with musical or prosodic stimuli, the brain may partly use similar neural systems to process and identify emotions, systems that are also involved in social cognition (Escoffier, Zhong, Schirmer,& Qiu, 2013; Peretz, 2010). In this regard, music's similarity to prosody, which commonly infers emotional information in social interactions, links musical emotion recognition to social cognition skills. Ultimately, it makes it all the more relevant to investigate music within the framework of age-related emotion recognition ability.

However, far fewer studies have analyzed the recognition of emotions expressed by music than by faces in normal aging. Vieillard et al. (2008) developed and validated a set of short musical excerpts (expressing happiness, sadness, scary/threat and peacefulness) that were used in different studies on emotion recognition. One such study (Lima and Castro; 2011) reports an age-related decrease in the recognition of fear and sadness expressed by music, whereas happiness and peacefulness recognition remained unaffected by age. Consistently, the same outcomes were reproduced in a later study by the same authors (Castro & Lima, 2014),

hence corroborating with Laukka and Juslin's (2007) results, whom had also observed a decrease in the elderly's recognition of fear and sadness, as expressed by music. Again, those results tend to support a positivity effect among the elderly. However, while Pearce and Halpern (2015) reported that the elderly rated sad music as much less sad, and fearful music more positively than younger adults did, they also rated happy music as less happy than younger adults did, which could reflect a more generalized central tendency bias in elderly subjects, rather than a positive bias. Nonetheless, the difference between the elderly and adults was about twice as great for sadness as for happiness, possibly bringing modest support to a positivity effect among the elderly.

These results all indicate that age-related changes in the capacity to recognize emotions do not affect all emotions in the same way. Many hypotheses have been formulated to explain this phenomenon, including the socioemotional selectivity and neurological theories.

The first proposed explanation emerged from the positivity effect among the elderly. To explain this phenomenon, the socioemotional selectivity theory stipulates that, as people age, they perceive their time as increasingly narrow to such a degree, that they will further prioritize goals that have an emotional valence, such as maintaining positive affects, upholding close relationships, and gaining greater emotional meaning from life, rather than performance-oriented goals like their younger counterparts. The age-related differences observed in emotion recognition would thus come from a motivational shift. (Carstensen, 2006; Carstensen, Fung, & Charles, 2003; Carstensen, Isaacowitz, & Charles, 1999; Carstensen and Mikels, 2005; Charles, Mather, & Cartensen, 2003; Lockenhoff & Cartensen, 2007; Mather & Cartensen, 2005; Reed & Cartensen, 2012; Reed et al. 2014).

In turn, the neurological theory stipulates that the age-related difficulties observed in emotion recognition are caused by specific neural changes that occur in normal aging. The presence of atrophy in specific brain regions, especially in the frontal and temporal areas, has been identified in elderly people (Allen, Bruss, Brown, & Damasio, 2005; Bartzokis et al., 2001). These age-related changes have received much attention from certain researchers, who have tried to link the cerebral changes with their behavioural effects, including those affecting the process of emotion recognition. For instance, the recognition of anger seems to particularly involve the orbitofrontal cortex according to a meta-analysis by Murphy, Nimmo-Smith, and Lawrence (2003) and a study by Blair, Morris, Frith, Perrett, and Dolan (1999).

The recognition of sadness is known to be specifically related to the anterior cingulate cortex (Blair et al., 1999), whose volume (Ohnishi, Matsuda, Tabira, Asada, & Uno, 2001) and metabolism decline with age (Petit-Taboué, Landeau, Desson, Desgranges, & Baron, 1998).

The recognition of fear, on the other hand, seems to be mainly related to the amygdala (Adolphs, Tranel, Damasio, & Damasio, 1994), whose volume reduces linearly with advancing age (Allen et al., 2005). Moreover, amygdala's involvement has been demonstrated not to be limited to the recognition of fearful facial stimuli, as it is also involved in the recognition of scary musical stimuli (Gosselin, Peretz, Hasboun, Baulac, & Samson, 2011; Gosselin, Peretz, Johnsen, & Adolphs, 2007; Gosselin et al., 2005).

There is still little information on which cerebral regions are primarily involved in the recognition of surprise. Meanwhile, the recognition of happiness seems to involve more structures than anger, fear and sadness, possibly contributing to its preservation (see Ruffman et al., 2008, for a review). To our knowledge, while some are growing older, recent studies do not discredit past results regarding the general brain regions responsible for emotion recognition,

but rather investigate more extensive neural systems and time frames that are too complex for the purpose of the present study.

In summary, the literature acknowledges that the elderly recognize emotions differently than adults. The results of past studies seem to indicate a tendency in the elderly, comparatively to adults, to recognize all facial emotions less accurately, but particularly the negative ones, while for musical emotions this lower accuracy is only reported for negative emotions, and not for positive ones. However, the scope of the differences that characterize the emotion recognition capacity in normal aging remains uncertain, and the specific effect for each emotion seems to depend on the medium used.

Besides, previous observations on the age-related changes in emotion recognition may have emerged from methodological shortcomings in certain studies. Numerous factors other than age may impact emotion recognition, making it imperative to control for those factors through additional measurements and exclusion criteria. For example, depression can influence emotion recognition by increasing the sensitivity of depressed patients to negative emotional stimuli in both musical and facial modalities (Orgeta, 2014; Naranjo et al., 2011; Punkanen, Eerola, & Erkkilä, 2011). Indeed, results regarding happiness recognition are sometimes inconsistent between studies. For example, Horning et al. (2012) report that older adults recognize happiness less accurately than younger ones, while Circelli et al. (2013) found no such age-related impairment for this particular emotion. Interestingly, in these two studies, only Circelli et al. (2013) controlled for depression symptoms. One could therefore speculate that methodological differences may partly explain their inconsistent results.

Culture is also an important factor. Indeed, the mechanisms involved in the recognition of facial emotion differ between cultures (Biehl et al., 1997; Blais, Jack, Scheepers, Fiset, &

Caldara, 2008; Jack, Blais, Scheepers, Schyns, & Caldara, 2009). Moreover, since listeners are implicitly exposed to cultural rules concerning musical structures, they tend to have an easier time recognizing emotional cues in music from their own culture (Laukka, Eerola, Thingujam, Yamasaki, & Beller, 2013). Furthermore, a previous study showed musical expertise (specialized musical knowledge) is a factor of emotion recognition in music (Castro & Lima, 2014). Finally, dementia is associated with modifications of the emotion recognition process for faces (Drapeau, Gosselin, Gagnon, Peretz, & Lorrain, 2009; Gagnon, Gosselin, Provencher, & Bier, 2012; Henry et al., 2008).

One other important factor is individual differences. Evaluating the same participants on both modalities would allow us to reduce individual factors to assess with greater confidence whether age-related emotion recognition differs depending on the medium used, and how so. Furthermore, there are multiple differences between facial and musical stimuli, namely regarding their form (in most studies there are static visual stimulus and dynamic auditory stimulus presented). Thus, if age affects facial and musical emotion recognition differently, one could argue that age-related changes in emotion recognition might rely on modality-specific mechanisms, which may help us to better understand how those underlying mechanisms work. But this would require control for individual factors when comparing responses to both modalities under the same methodology.

To our knowledge, only two studies have evaluated the effect of age on both facial and musical emotion recognition within the same group of participants. Brosgole and Weisman (1995) found a progressive decline in facial affect recognition, the main problem being related to recognizing angry faces. In musical affect recognition, the elderly were worse at detecting anger and sadness, but not happiness. However, facial stimuli were black and white drawings

of cartoon animals, not human faces. Besides, musical selections were not original excerpts (but from popular music from the 1930s and 1940s, jazz and classical arrangements, all played by professional jazz bands), which may have added a certain familiarity effect to the results.

Sutcliffe et al. (2017) examined the differences between young and old in emotion recognition of face and music stimuli in two main sets of experiments. They concluded that the elderly were less accurate in each task. They also reported a specific difficulty in recognizing happy, sad, peaceful, angry and fearful music. However, it is not clear if procedures were equivalent in judging musical and facial emotional expressions. More importantly, they used stimuli for which emotion recognition already included judgements from the elderly, which, from our understanding, do not allow to really measure the effect of aging on emotional recognition.

The general objective of the present study is therefore to explore the capacity of elderly people to recognize basic emotions expressed by both facial and musical stimuli. Based on current knowledge, it was hypothesized that, for facial stimuli, the recognition of happiness and surprise should be less influenced by age than the recognition of fear, sadness and anger, even if all emotions might be less accurately recognized by elderly than by adults. For musical stimuli, it was hypothesized that the recognition of happiness should remain stable, while the recognition of fear and sadness should be less accurately recognized by the elderly.

Method

Participants

Seeing as it is difficult to objectively determine the precise moment when an adult becomes elderly, we relied on a standard cut-off point (aged 65 and older) (Chappell, Gee,

McDonald, & Stones, 2003; Statistics Canada, 2006). As for the adult group, the cut-off points varied between Quebec's legal age (18 years old) and 50 years old. Indeed, no participants were recruited between 51 and 64 years old, as to create a reasonable distance between the two groups. Thirty-four French-speaking volunteers, aged between 65 and 87 years old in the elderly group and 31 others aged between 18 and 50 years old in the adult comparison group took part in this study (see Table 1).

Although, there is a slight tendency towards significance, the two groups did not differ significantly according to their years of formal education ($t(63) = 1.80$, $p = 0.076$). Furthermore, a correlation of Pearson was computed to assess the relationship between the years of formal education and performances to both experimental tasks (facial and musical). Results indicate that there is no correlation between the years of formal education and the performance to the facial task ($r\,(62) = 0.08$, $p = 0.56$) or to the performance to the musical task ($r\,(62) = 0.13$, $p = 0.30$). Even if there were more women in each group, the two groups did not differ significantly according to gender ($\chi^2\,(1) = 1.14$, $p = 0.29$).

We used the short version (GDS-S; Sheikh & Yesavage, 1986) of the Geriatric Depression Scale (GDS; Yesavage et al., 1986) as a quick depression screening tool. It was originally created for the elderly population, but also proven valid among younger adults in a study conducted with participants aged between 17 and 30 years old (Ferraro & Chelminski, 1996). The two groups did not differ significantly according to their GDS-S score ($t(61) = 0.44$, $p = 0.661$).

Exclusion criteria for participants include the presence of signs of impaired general cognitive functioning, as assessed in the elderly by the Mini-Mental State (3MS; Hébert & Girouard, 1992) and the Dementia Rating Scale (DRS; Mattis, 1976; Pillon & Huguonot-Diener,

2013), while for adults, the MMS and DRS were replaced by the Raven's Progressive Matrices (Raven, Raven & Court, 1977). None of the participants reached pathological thresholds on the above tests.

All participants were from the Western culture, or had lived in it for at least 5 years. No participant was a musician/had specialized musical knowledge (e.g., knowing the theoretical difference between the minor and major modes). In addition, none of the participants had any neurological or psychiatric history, nor had they taken psychotropic drugs nor had they been under general anaesthesia during the past year. A questionnaire on medical history also ascertained that none of the participants had an uncorrected visual or hearing deficit.

<Insert Table 1 about here>

Experimental tasks

Two computerized recognition tasks, adapted in Peretz's laboratory at the International Laboratory for Brain, Music and Sound Research (BRAMS) in Montreal, were used in this study. Neutral stimuli are presented longer than necessary, and participants are asked to state their answers orally, because the tasks were originally adapted to include exploratory psychophysiological measures through electrode installation. However, these measures were not used in this study.

Recognition of facial emotions. The task included a set of 30 black-and-white photographs of faces, taken from the Pictures of Facial Affect (Ekman & Friesen, 1976). The photographs depicted faces expressing happiness, sadness, fear, anger or surprise, and all expressed a moderate emotional intensity level according to the results of Ekman and Friesen's original study. The five basic emotions above were chosen instead of more complex ones, since

there is still a lot to be understood about the recognition of basic emotions before we can explore the processing of complex emotions, such as shame and envy.

Each of the 30 photographs (six photographs for each emotion) appeared on a computer screen only once for 8 seconds, and was always followed by vertically presented answer options (happiness, sadness, fear, anger and surprise) from which the participant had to orally state an answer. Once the participant's answer was given, a neutral stimulus (a black cross on a white background) appeared on the computer screen for 20 seconds (see Figure 1). Two practice trials with feedback from the interviewer were presented first to ensure that the instructions were well understood.

Recognition of musical emotions. The task included a set of 18 original short musical excerpts, computer-generated on a piano tone by a MIDI sequencing program. The excerpts lasted from 8 to 12 seconds each, and expressed three of the six basic emotions: happiness, sadness and fear. These excerpts were rigorously developed and validated (Vieillard et al., 2008). Happiness, sadness and fear were chosen because, according to norms (Vieillard et al., 2008), they are basic emotions that are more clearly expressed by music. As for faces, each excerpt was presented in full only once, and was always followed by vertically presented answer options on the same computer screen (happiness, sadness and fear) from which the participant had to orally state an answer. Once the participant's answer was given, a neutral stimulus appeared for 20 seconds before the next excerpt was presented (see Figure 2). Two practice trials with feedback were presented first (i.e. excerpts from the soundtracks from the movies *Jaws* and *Schindler's List* as examples of fear and sadness, respectively).

Procedure

The study took place at the Research Centre on Aging's Cognition-Emotion Laboratory of the Health and Social Services Centre – CIUSSS de l'Estrie – CHUS. It was carried out in a single, one and a half hour session. First, the consent form was signed by the participant and the researcher in charge of the project. Then, the neuropsychological assessment of the participant was conducted to rule out the presence of cognitive deficits (MMS, and DRS for elderly participants, and Raven's Matrices for the adult group) and evaluate depression symptoms (GDS-S). Finally, participants were asked to complete the experimental tasks, the order of presentation inverted for half of the participants.

Results

Mean scores were calculated from the percentages of correct categorization obtained by the elderly and adult participants in the facial and musical tasks (see Tables 2 and 3). To compare scores for each emotion for the two groups, repeated measures analyses of variance (ANOVAs) were performed separately for each experimental task, with Group (elderly and adults) as the between-participants variable and Emotional Category (facial task: happiness, sadness, fear, anger and surprise; musical task: happiness, sadness and fear) as the within-participants variable. The majority of the experimental variables studied did not meet the normality postulate, even after nonlinear transformations. In view of the ANOVA's robustness to normality postulate violations (Howell, 2008), the original variables were used in all analyses and the Greenhouse-Geisser correction was applied in accordance with Mauchly's sphericity postulate violation. Original untransformed variables were also used when performing the multiple comparison analyses (tests-t), for which a Bonferroni correction was applied.

Recognition of facial emotions

The analyses revealed no significant interaction between Group and Emotional Category ($F(2, 119) = 1.65$, $p = 0.199$). There was a main effect of Group ($F(1, 63) = 18.29$, $p < 0.001$; $\eta^2_p = 0.23$): the elderly group ($M = 91.47$; $SD = 6.67$) was worse at recognizing all five basic emotions than the adults group ($M = 96.99$; $SD = 4.57$). A significant main effect of Emotional Category ($F(2, 119) = 25.71$, $p < 0.001$; $\eta^2_p = 0.29$) was also revealed. To compare the percentages of correct categorization for facial emotions, multiple comparisons (test-t) were performed, for which a Bonferroni correction was applied ($\alpha = 0.006$). As happiness and fear were respectively the most and the less accurately categorized emotions, they were compared to one another and also to the other facial emotions (sadness, anger and surprise). The only differences obtained demonstrate that adults were less accurate in the recognition of fear than happiness ($t(30) = 5.66$, $p < 0.001$); sadness ($t(30) = 5.34$, $p < 0.001$; $d = 1.09$); anger ($t(30) = 5.07$, $p < 0.001$; $d = 0.91$) and surprise ($t(30) = 5.05$, $p < 0.001$; $d = 1.16$). The same pattern was observed for the elderly as the only differences obtained demonstrate that the elderly were less accurate in the recognition of fear than happiness ($t(33) = 4.63$, $p < 0.001$; $d = 0.79$); sadness ($t(33) = 4.41$, $p < 0.001$; $d = 0.76$); anger ($t(33) = 3.08$, $p < 0.001$; $d = 0.65$) and surprise ($t(33) = 3.08$, $p < 0.001$; $d = 0.60$).

As Table 2 shows, both groups' responses seem to indicate some confusion about faces representing fear, as the elderly and adults tended to categorize them as representing surprise, respectively in 94.00% and 91.67% of all cases of confusion.

<Insert Table 2 about here>

Recognition of musical emotions

The analyses revealed a significant interaction between Group and Emotional Category ($F(1, 82) = 9.75$, $p = 0.001$; $\eta^2_p = 0.13$). To compare the percentages of correct categorization for musical emotions, multiple comparisons (test-t) were performed, for which a Bonferroni correction was applied ($\alpha = 0.008$). Adults were less accurate in the recognition of fear compared to happiness ($t(30) = 3,24$, $p = 0.003$; $d = 0.58$) and compared to sadness ($t(30) = -3.24$, $p = 0.003$; $d = 0.58$). The same pattern was observed among the elderly as they were also less accurate in the recognition of fear compared to happiness ($t(33) = 6.46$, $p < 0.001$; $d = 1.27$) and compared to sadness ($t(33) = 5.52$, $p < 0.001$; $d = 1.11$). However, the elderly were less accurate than adults in the recognition of fear ($t(57) = 4.14$, $p < 0.001$; $d = 1.02$) and sadness ($t(33) = 3.28$, $p = 0.002$; $d = 0.80$), while no statistically significant difference was observed between the groups for the recognition of happiness ($t(33) = 1.79$, $p = 0.083$).

No particular pattern of confusion seems to be identifiable in the musical task (see Table 3). In the elderly group, misclassification of musical excerpts expressing fear tended to be distributed at chance level between happiness and sadness, that is respectively in 53.19% and 46.81% of all cases of confusion. Similarly, adults misclassified excerpts expressing fear as happiness or sadness, respectively in 46.15% and 53.85% of all cases of confusion.

<Insert Table 3 about here>

Discussion

The general objective of the present study was to explore the capacity of elderly people to recognize emotions expressed by both facial and musical stimuli.

Facial emotion recognition

For facial emotions, it was hypothesized that all emotions might be less accurately recognized by the elderly compared to adults, while the recognition of happiness and surprise should be less influenced by age than the recognition of fear, sadness and anger, in accordance with the socioemotional selectivity theory (SST) that predicts a better preservation of the recognition of positive information with aging.

To test our hypotheses, the ability of a group of elderly to recognize five facially expressed emotions (happiness, sadness, fear, anger and surprise) was compared to the ability of a group of younger adults. As predicted, this comparison revealed that the elderly participants significantly recognized the five facial emotions tested less easily than the adult group. This is consistent with Ruffman et al.'s (2008) meta-analysis, which found a significant age-related impairment for the recognition of the same five emotions, as expressed by facial stimuli.

However, contrary to expectations, the present results did not confirm that the recognition of more positive emotions is less influenced by age than the recognition of negative ones. Indeed, no interaction was obtained between age group and emotion. This prediction had been speculated considering other study results suggesting that there is an interaction between the recognition of certain emotions and age group. The elderly are expected to find it more difficult than adults to recognize anger (Calder et al., 2003; Hot et al., 2013; Orgeta & Phillips, 2008; Phillips et al., 2002; Ruffman et al., 2009; Williams et al., 2009), sadness (Calder et al., 2003; Orgeta, & Phillips, 2008; Phillips, et al., 2002; Ruffman et al., 2009) and fear (Calder et al., 2003; Isaacowitz et al., 2007; Orgeta & Phillips, 2008; Williams et al., 2009). The effect of age on the ability to recognize happiness and surprise is usually found to be less marked (see Ruffman et al., 2008, for a review); in fact, a more recent meta-analysis (Reed et al. 2014) has

reported the presence of a positivity effect among the elderly, which means that the ability to recognize positive emotions should be relatively preserved.

It should also be noted that, even though all the emotions were less accurately recognized by the elderly, the confusion patterns were similar in both groups. Indeed, for both age groups, fear was the hardest emotion to recognize, while happiness was the easiest. No other significant difference was found between facial emotions. This finding is congruent with other studies that described fear as one of the most difficult facial emotions to recognize (Montagne et al., 2007; Rapcsak et al., 2000; West et al. 2012) and happiness being the easiest one (Chiu et al. 2015; Horning et al., 2012; Montagne et al., 2007; West et al., 2012; Williams et al., 2009). Happiness is subsequently often characterized by a ceiling effect (see Ruffman et al., 2008, for a review), as it is the case in the present study. Moreover, fear was mainly confused with surprise by both groups, as is also reported in previous studies, possibly because of the physical similarities between the two emotions (Beer et al., 2015; Calder et al., 2003; Rapcsak et al., 2000). It would seem natural to wonder if fear recognition would have been quite so impaired if surprise had not been part of the study. It is very possible that it would have been, as fear was still significantly less well-recognized by the elderly in another study that did not include surprise (Williams et al., 2009). Furthermore, the difference in performance between the recognition of fear and happiness is not statistically different between the two age groups. This could align with the main results which indicate that every emotion is less recognized by the elderly than adults.

Taken together, these results tend to partly support that the ability to recognize facial emotions is not a global process; rather, it depends on the specific emotion that is expressed (Chiu et al. 2015; Horning et al., 2012; West et al., 2012; see Ruffman et al., 2008, for a review),

regardless of age. Indeed, our results suggest that the elderly and young to middle-aged adults may recognize all emotions in the same way (e.g., fear was more difficult to recognize than any other emotion for both groups). However, it does not support claims that the elderly are less accurate than adults in the recognition of negative facial emotions, compared to positive ones. The fact that the confusion patterns remained similar in both groups, while the elderly group recognized all the emotions less accurately than the control adults, might be interpreted as indicating poorer acuity of their emotion recognition capacity, rather than a positive bias.

Musical emotion recognition

For musical emotions, it was hypothesized that the recognition of happiness shall not differ between the elderly and adults, while the recognition of fear and sadness (so-called negative emotions) shall be less accurately recognized by the elderly.

To test our hypotheses, the ability of the same groups of elderly and adults to recognize three basic emotions expressed by music (happiness, sadness and fear) was compared. The results were congruent with our hypothesis and previous literature, as they showed an interaction between emotion and age group, indicating that the elderly were less accurate than adults in the recognition of fear and sadness, while no difference was observed for the recognition of happiness. Indeed, Laukka and Juslin's (2007) study showed that fear and sadness, as expressed by different interpretations of the same song, were significantly less well-recognized by the elderly, than by adults. Using the same stimuli as in the present study, two studies (Castro and Lima, 2014; Lima and Castro, 2011) drew similar conclusions: they found that the recognition of scary and sad music was impaired, while the recognition of happy and peaceful music was preserved in advancing age. Furthermore, in the present study, the difference in performance between the recognition of fear and happiness is statistically different between the two age

groups. This could align with the main results which indicate that fear is less recognized by the elderly than adults, while happiness is recognized equally by both groups. Thus, the present results regarding musical emotion may seem to clearly support the presence of a positivity effect among the elderly. However, confusion patterns may bring doubt to this conclusion, since fear was confused equally with a positive and a negative emotion, as will be discussed further.

Facial and musical emotion recognition

When comparing the results across the facial and musical modalities, one can observe heterogeneity on the effects of age on emotion recognition. Specifically, age had a different effect on happiness recognition when expressed by faces, versus music. Indeed, happiness as expressed by faces was less accurately recognized by elderly participants, while happiness as expressed by music remained equally recognized between both age groups. The differences between the two sensory modalities may be caused by their respective static and dynamic aspects. However, the comparison between faces and music is difficult to reduce only to this aspect. So far, studies that used dynamic facial stimuli and studies that used traditional static facial stimuli have produced quite similar results. For instance, according to the studies based on dynamic stimuli, once again, the elderly have more difficulty than adults in recognizing anger (Montagne et al., 2007; Sullivan & Ruffman, 2004; West et al., 2012), sadness (Horning et al., 2012; Montagne et al., 2007; Sullivan & Ruffman, 2004; West et al., 2012) and fear (Horning et al., 2012; Montagne et al., 2007; Sullivan & Ruffman, 2004; West et al., 2012). They sometimes also find it more difficult to recognize happiness (Horning et al., 2012; Montagne et al., 2007). Thus, although some authors have claimed that dynamic facial stimuli are superior to static ones (Horning et al., 2012; West et al., 2012; see Isaacowitz & Stanley, 2011, for a review), this claim remains questionable (see Ruffman, 2011, for a commentary).

Consequently, it is possible that the present findings more likely indicate differential emotional information processing, depending on the sensory modality that is used to express happiness, in relation with a top-down motivational system, as will be discussed further.

Explanatory theories

The facial task results of this study are not consistent with an age-related positivity effect, since no significant difference was found between the recognition of positive and negative emotions. However, the musical task's results are congruent with an age-related positivity effect, as the elderly had more difficulty than adults recognizing negative emotions (fear and sadness) compared to happiness. The aforementioned socioemotional selectivity theory could at least partly explain this effect. Indeed, this theory postulates that the purpose of the elderly favoring positive stimuli over negative ones include upholding close relationships, as well as maintaining positive affects. Since music is known to be a strong and very effective medium of emotional evocation (Peretz, 2010; Vieillard et al., 2008), it seems natural that a positivity effect should appear in such a distinct manner within the results of a musical emotion recognition task. However, it is intriguing that this effect did not also prominently show up in the facial task's results. Former studies seem to indicate that gazing patterns (which appear futile in musical tasks) may facilitate a positive bias (Calder et al., 2000; Circelli et al.,2013; Isaacowitz et al., 2006a; Isaacowitz et al., 2006b; Opitz et al., 2012; Sullivan et al., 2007), which again begs the question of why such a bias was found within the musical task, but not the facial one. Nonetheless, this absence of significant difference between the recognition of positive and negative facial emotions could possibly be explained by several limitations. In future studies, it would be interesting to go further into our understanding of the relationship between emotion recognition and the elderly's positive bias, notably through psychometric measures of positivity

(Caprara et al., 2012). Moreover, a method that specifically addresses the question of whether stimuli are positive or negative would be necessary. In this sense, confusion patterns from both the adults and elderly groups in the musical task showed that fear tended to be distributed at chance level between happiness and sadness, which suggests that fear might as well be confused with another negative emotion. But is sad music always perceived as negative? Since sad excerpts might be located on the pleasant part of the valence dimension (Vieillard et al., 2008), it could finally be concluded that results obtained for music did not show a positivity effect as well, because with music, sad excerpts could be considered positive. However, in a study that examined if the elderly may differ in their rating of some of Vieillard et al.'s (2008) stimuli, Narme, Peretz, Strub and Ergis (2016) found that the elderly rated sad excerpts as being unpleasant. Accordingly, an explicit question as to whether stimuli are perceived as positive or negative thus really seems to be necessary in future studies to explore any positivity effect.

Otherwise, our results for both tasks (facial and musical) may partly be in accordance with the neuropsychological explanation of the age-related differences in emotion recognition capacity. Indeed, it is possible that specific neural changes occurring in normal aging may partially be responsible for the differences observed between the elderly and adults in their emotion recognition abilities. For example, as mentioned before, the recognition of sadness is known to be specifically related to the anterior cingulate cortex (Blair et al., 1999), whose volume (Ohnishi et al., 2001) and metabolism decline with age (Petit-Taboué et al., 1998). It is also possible that fear recognition was affected by neural modifications, since the volume of the amygdala decreases linearly in normal aging (Allen et al., 2005), and this cerebral structure is known to be important in the recognition of fear as expressed by faces (Adolphs, 2008; for a review) as well as music (Gosselin et al., 2005, 2007, 2011). This could be in line with Mather

et al.'s (2004) findings that the elderly perceive negative pictures as less arousing compared to adults and that less activity is detected in their amygdala while they are exposed to negative pictures. Although the neurological explanation could partly explain results regarding fear recognition, the fact remains that fear is harder to recognize than any other emotion regardless of age, whether it is expressed by facial or musical stimuli. Further exploration is necessary to clarify the role of the amygdala in this disparity.

Besides, factors relevant to executive functions may also have to be considered. Some studies report that, compared to younger adults, older ones look more at the lower part of faces (mouth area) than at the upper part (eye area) (Circelli et al.,2013; Sullivan, Ruffman, & Hutton, 2007). According to Calder, Young, Keane, and Dean (2000), the upper area is associated with better recognition of anger, fear and sadness, while the lower half of the face is associated with better recognition of happiness and disgust. Hence, the elderly's gazing pattern could indicate that they tend to shift their attention towards positive stimuli, as supported by the socioemotional theory. However, Adolph (2008) reported that lesions to the amygdala result in a lesser fixation to the area of the eyes, resulting in difficulty to recognize fear as expressed by facial stimuli. Thus, an age-related reduction of the amygdala's volume could also be in cause. Nonetheless, additional studies using the recording of eye movement reported that the elderly tend to shift their attention towards happy faces and away from angry and sad faces (Isaacowitz, Wadlinger, Goren, & Wilson, 2006a; Isaacowitz, Wadlinger, Goren, & Wilson, 2006b), which once more seems congruent with the socioemotional explanation. Indeed, since Opitz, Ranch, Terry and Urry (2012) propose that attention deployment strategies are a non-negligible aspect of emotion regulation among the elderly, one could argue that the avoidance of negative faces may reflect an intent to preserve positive affect. Possibly as a result, further studies have observed that

elderly participants tend to judge negatively-valenced faces as more positive and trustworthy and less hostile and dangerous than younger ones do (Ruffman, Sulivan, & Edge, 2006; Castle et al., 2012; Zebrowitz, Franklin, Hillman, & Boc, 2013). Finally, Vieillard and Bigand (2014) observed that the elderly report having greater positive feelings towards happy music and experiencing lower emotional activation while listening to threatening music than younger adults do, which in accordance to the socioemotional selectivity theory may be interpreted as a propensity to maintain positive affects.

In this regard, a meta-analysis (Reed et al., 2014) studying the elderly's positivity effect on attention and memory might be insightful on the possible origin of the differences observed between modalities. It reports that the age-related positivity effect's magnitude is larger within studies that do not impose experimental constraints on cognitive processing compared to those that do. Thus, slight variations between study results on age-related facial emotion recognition may be partly explained by differences in experimental manipulations. They rely on the socioemotional theory to propose that the elderly's information processing might reflect a top-down motivational system. Thus, cognitive constraints might distract them from such top-down control, diminishing the forceful preservation of positive emotion recognition. In the present study, the facial task might have been perceived by the elderly as more businesslike and the musical task as more lively and enjoyable, as music is typically associated to leisure activities outside of experimental contexts. Furthermore, music is known to activate neural systems responsible for reward and pleasure (Zatorre, & Salimpoor, 2013). In sum, they may instinctively retreat to a preferential information processing mode when put at ease by the pleasant nature of the musical task. This explanation is congruent with the positivity effect among the elderly and its socioemotional explanation.

Some other limitations must be considered in interpreting the present results. It would have been relevant to compare the two modalities statistically. However, this was not possible since the salience of the stimuli used were not proven equivalent between the two tasks. Future studies should use stimuli with equivalent salience between modalities to render possible their comparison. Moreover, an explanation for the differences observed between modalities might be that the stimuli in the two tasks did not express the emotions with equivalent intensity, possibly resulting in sensitivity differences between the tasks. Furthermore, our elderly participants were still very good at categorizing facial emotions and our young to middle-aged participants often presented ceiling effects. Accordingly, one might hypothesize that, if the stimuli were less salient, they might result in the observation of more significant differences between age groups for some emotions. However, we used pictures of faces expressing a moderate emotional intensity, which was justified since Orgeta and Phillips (2008) and West et al. (2012) reported that facial emotional stimuli generally discriminate most between adults and elderlies when they express the emotion at the 50% intensity level.

Besides, a lack of sensitivity in the tasks (as potentially indicated by the ceiling effects found) and the limited sample size might not have allowed for a statistically significant interaction between age groups and specific emotions in the facial task, hence explaining, at least in part, the differences obtained relative to the results found in most of the existing literature on the subject. Furthermore, the age difference for the recognition of musically expressed happiness had a slight tendency towards significance ($p = 0.083$). It is possible that a larger size sample might have allowed for a statistically significant age-related decline the recognition of happiness as expressed by music. Future studies might be able to shed light on this matter. Moreover, the control group in the present study included participants in late middle

age (up to 50). As studies revealed a linear decrease in the recognition of fear across the lifespan beginning around the age of 40 (Calder et al., 2003; 60 years according to West et al., 2012), some of the participants from the control group might have already had an age-related difference on their recognition of fear. This could at least partly explain the absence of an interaction effect between group and emotion on the facial stimuli task. Thus, future studies should pay attention to a more restrictive delimitation of the age groups. Considering that the present study is transversal, we cannot rule out that a cohort effect might have influenced the results. For this purpose, more longitudinal studies are needed. Besides, a large number of both group's participants were women (79.4% of elderly and 67.7% of adults), which might have impacted the results, considering women's emotion recognition skills were reported as superior to those of men in multiple studies (Bonebright, Thompson, & Leger, 1996; Hall, 1978; Mill, Allik, Realo, & Valk, 2009; Ruffman, Murray, Halberstadt, & Taumoepeau, 2010).

Conclusions

To summarize, the present study's results tend to support the idea that emotion recognition abilities differ between the elderly and adults. Furthermore, this divergence is present at least for some emotions, but not all of them, depending on the modality of expression. More specifically, the findings of this study partially support the hypothesis that it is more difficult for elderly than for adults to recognize negative emotions, rather than positive ones, at least when expressed by music. Indeed, the elderly participants had more difficulty recognizing fear and sadness expressed in music, while happiness recognition remained the same. Nevertheless, they had more difficulty recognizing all five facial emotions tested than the adult group. All in all, the present results partially support the positivity effect theory, as well as being

consistent with a neuropsychological perspective on the effect of aging on emotion recognition. Furthermore, fear was the most difficult facial emotion to recognize for both elderly and adults in both modalities, suggesting that this particular negative emotion might be impaired sooner in life.

This study makes a considerable contribution, especially by controlling for the presence of cognitive deficits and depressive symptoms among participants, while simultaneously experimenting the recognition of emotions expressed by two different modalities (faces and music) from the same group of participants. It also considered the specific confusion patterns in each age group, which deserve more attention in subsequent, preferably longitudinal studies, to increase our understanding of the factors underlying the origins of the differences between emotions and modalities in age-related emotion recognition changes.

Considering the steady increase in the elderly population, the potential consequences of age-related changes in emotion recognition abilities, and the relative preservation of the recognition of happiness as expressed by music, the latter might become privileged as a clinical tool to promote well-being, which in itself highlights the importance of pursuing research in this field of knowledge.

References

Adolphs, R. (2008). Fear, Faces, and the Human Amygdala. *Current Opinion in Neurobiology*, *18*(2), 166-172.

Adolphs, R., Tranel, D., Damasio, H., & Damasio, A. (1994). Impaired recognition of emotion in facial expressions following bilateral damage to the human amygdala. *Nature*, *372*, 669-672.

Allen, J. S., Bruss, J., Brown, C. K., & Damasio, H. (2005). Normal neuroanatomical variation due to age: The major lobes and parcellation of the temporal region. *Neurobiology of Aging*, *26*, 1245-1260. doi:10.1016/j.neurobiolaging.2005.05.023

Bartzokis, G., Beckson, M., Lu, P. H., Nuechterlein, K. H., Edwards, N., & Mintz, J. (2001). Age-related changes in frontal and temporal lobe volumes in men: A magnetic resonance imaging study. *Archives of General Psychiatry*, *58*, 461-465.

Beer, J. M., Smarr, C., Fisk, A. D., & Rogers, W. A. (2015). Younger and older users' recognition of virtual agent facial expressions. *International Journal Of Human-Computer Studies*, *75*, 1-20. doi:10.1016/j.ijhcs.2014.11.005

Biehl, M., Matsumoto, D., Ekman, P., Hearn, V., Heider, K., Kudoh, T., & Ton, V. (1997). Matsumoto and Ekman's Japanese and Caucasian Facial Expressions of Emotion (JACFEE): Reliability Data and Cross-National Differences. *Journal of Nonverbal Behavior*, *21*(1), 3-21. doi:10.1023/a:1024902500935

Blair, R. J. R., Morris, J. S., Frith, C. D., Perrett, D. I., & Dolan, R. J. (1999). Dissociable neural responses to facial expressions of sadness and anger. *Brain*, *122*, 883-893.

Blais, C., Jack, R. E., Scheepers, C., Fiset, D., & Caldara, R. (2008) Culture shapes how we look at faces. *PLoS one*, *3*(8), e3022. doi:10.1371/journal.pone.0003022

Bonebright, T. L., Thompson, J. L., & Leger, D. W. (1996). Gender stereotypes in the expression and perception of vocal affect. *Sex Roles*, *34*(5-6), 429-445.

Bravo, G. & Hebert, R. (1997). Age- and education-specific reference values for the Mini-Mental and modified Mini-Mental State Examinations derived from a non demented elderly population. *International Journal of Geriatric Psychiatry*, 12, 1008-1018 .

Brosgole L., & Weisman, J. (1995) Mood recognition across the ages. *International Journal of Neuroscience*, *82*(3-4), 169-189.

Calder, A. J., Keane, J., Manly, T., Sprengelmeyer, R., Scott, S., Nimmo-Smith, I., & Young, A. W. (2003). Facial expression recognition across the adult life span. *Neuropsychologia*, *41*, 195-202.

Calder, A. J., Young, A. W., Keane, J., & Dean, M. (2000). Configural information in facial expression perception. *Journal of Experimental Psychology: Human Perception and Performance*, *26*, 527-551. doi:10.1037//0096-1523.26.2.527

Caprara, G. V., Alessandri, G., Eisenberg, N., Kupfer, A., Steca, P., Caprara, M. G., Yamaguchi, S., Fukuzawa, A., & Abela, J. (2012). The Positivity Scale. *Psychological Assessment*, *24*(3), 701-712.

Carstensen, L. L. (2006). The Influence of a Sense of Time on Human Development. *Science*, *312*(5782), 1913-1915.

Carstensen, L. L., Fung, H. H., & Charles, S. T. (2003). Socioemotional selectivity theory and the regulation of emotion in the second half of life. *Motivation And Emotion*, *27*(2), 103-123. doi:10.1023/A:1024569803230

Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*, *54*(3), 165-181. doi:10.1037/0003-066X.54.3.165

Carstensen, L. L., & Mikels, J. A. (2005). At the Intersection of Emotion and Cognition: Aging and the Positivity Effect. *Current Directions In Psychological Science*, *14*(3), 117-121.

Carton, J. S., Kessler, E. A., & Pape, C. L. (1999). Nonverbal decoding skills and relationship well-being in adults. *Journal of Nonverbal Behavior*, *23*, 91-100. doi:10.1023/A:1021339410262

Castle, E., Eisenberger, N. I., Seeman, T. E., Moons, W. G., Boggero, I. A., Grinblatt, M. S., & Taylor, S. E. (2012). Neural and behavioral bases of age differences in perceptions of trust. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(51), 20848-20852. doi: 10.1073/pnas.1218518109

Castro, S. L., & Lima, C. F. (2014). Age and musical expertise influence emotion recognition in music. *Music Perception*, *32*(2), 125-142. doi:10.1525/mp.2014.32.2.125

Chaby, L., Luherne-du Boullay, V. L., Chetouani, M., & Plaza, M. (2015). Compensating for age limits through emotional crossmodal integration. *Frontiers In Psychology*, *6*, 691.

Chappell, N., L., Gee, E., McDonald, L., & Stones, M. (2003) *Aging in Contemporary Canada*. Toronto, ON: Prentice Hall.

Charles, S. T., Mather, M., & Carstensen, L. L. (2003). Aging and emotional memory: The forgettable nature of negative images for older adults. *Journal of Experimental Psychology-General*, *132*(2), 310-324.

Chiu, I., Gfrörer, R. I., Piguet, O., Berres, M., Monsch, A. U., & Sollberger, M. (2015). 'Now I see it, now I don't': Determining threshold levels of facial emotion recognition for use in patient populations. *Journal Of The International Neuropsychological Society*, *21*(7), 568-572. doi:10.1017/S1355617715000557

Circelli, K. S., Clark, U. S., & Cronin-Golomb, A. (2013). Visual scanning patterns and executive function in relation to facial emotion recognition in aging. *Aging, Neuropsychology, And Cognition*, *20*(2), 148-173.

Coutinho, E., & Dibbens, N. (2013) Psychoacoustic cues to emotion in speech prosody and music. *Cognition and Emotion*, *27*(4), 658-684. doi:10.1080/02699931.2012.732559

Dias, F., Teixeira, A. L., Guimaraes, H. C., Barbosa, M. T., Resende, E. P. F., Beato, R. G., Carmona, K. C., & Caramelli, P. (2017). Accuracy of the 15-item Geriatric Depression Scale (GDS-15) in a community-dwelling oldest-old sample: the Pieta Study. *Trends in Psychiatry and Psychotherapy, 39*(4), 276-279. doi:10.1590/2237-6089-2017-0046

Drapeau, J., Gosselin, N., Gagnon, L., Peretz, I., & Lorrain, D. (2009). Emotional recognition from face, voice and music in dementia of Alzheimer type: Implication for music therapy. *The Neurosciences and Music III: Disorders and Plasticity*, *1169*, 342-345. doi:10.1111/j.1749-6632.2009.04768.x

Ekman, P., & Friesen, W. V. (1976). *Pictures of Facial Affect*. Palo Alto. CA : Consulting Psychologists Press.

Escoffier, N., Zhong, J., Schirmer A., & Qiu, A. (2013) Emotional Expressions in Voice and Music: Same Code, Same Effect? *Human Brain Mapping*, *34,* 1796–1810.

Ferraro, F. R., & Chelminski, I. (1996). Preleminary normative data on the Geriatric Depression Scale – Short Form (GDS-SF) in a young adult sample. *Journal of Clinical Psychology*, *52*(4), 443-447.

Gagnon, L., Gosselin, N., Provencher, V., & Bier, N. (2012). Perception and emotional judgments of music in dementia of the Alzheimer type: A short case study. *Music Perception*, *29*, 509-519. doi:10.1525/mp.2012.29.5.509

Gosselin, N., Peretz, I., Hasboun, D., Baulac, M., & Samson, S. (2011). Impaired recognition of musical emotions and facial expressions following anteromedial temporal lobe excision. *Cortex*, *47*, 1116-1125. doi:10.1016/j.cortex.2011.05.012

Gosselin, N., Peretz, I., Johnsen, E., & Adolphs, R. (2007). Amygdala damage impairs emotion recognition from music. *Neuropsychologia*, *45*, 236-244. doi:10.1016/j.neuropsychologia.2006.07.012

Gosselin, N., Peretz, I., Noulhiane, M., Hasboun, D., Beckett, C., Baulac, M., & Samson, S. (2005). Impaired recognition of scary music following unilateral temporal lobe excision. *Brain*, *128*, 628-640. doi:10.1093/brain/awh420

Halberstadt, J., Ruffman, T., Murray, J., Taumoepeau, M., & Ryan, M. (2011). Emotion perception explains age-related differences in the perception of social gaffes. *Psychology and Aging*, *26*, 133-136. doi:10.1037/a0021366

Hall, J. A. (1978). Gender effects in decoding nonverbal cues. *Psychological Bulletin*, *85*(4), 845-857.

Hébert, R., & Girouard, D. (1992). *Manuel pour l'Administration et la Cotation de l'Échelle de Statut Mental Modifiée (3MS)*. Sherbrooke, QC : Centre de Recherche sur le Vieillissement.

Henry, J. D., Ruffman, T., McDonald, S., Peek O'Leary, M.-A., Phillips, L. H., Brodaty, H., & Rendell, P. G. (2008). Recognition of disgust is selectively preserved in Alzheimer's disease. *Neuropsychologia*, *46*, 1363-1370. doi:10.1016/j.neuropsychologia.2007.12.012

Horning, S. M., Cornwell, R. E., & Davis, H. P. (2012). The recognition of facial expressions: An investigation of the influence of age and cognition. *Aging, Neuropsychology, and Cognitio*n, *19*, 657-676. doi:10.1080/13825585.2011.645011

Hot, P., Klein-Koerkamp, Y., Borg, C., Richard-Mornas, A., Zsoldos, I., Paignon, A., Thomas Antérion, C., & Baciu, M. (2013). Fear recognition impairment in early-stage Alzheimer's disease: When focusing on the eyes region improves performance. *Brain and Cognition*, *82*, 25-34. doi:10.1016/j.bandc.2013.02.001

Howell, D. C. (2008). *Méthodes statistiques en sciences humaines (2nd ed.)*. Brussels: De Boeck Université.

Isaacowitz, D. M., Löckenhoff, C. E., Lane, R. D., Wright, R., Sechrest, L., Riedel, R., & Costa, P. T. (2007). Age differences in recognition of emotion in lexical stimuli and facial expression. *Psychology and Aging*, *22*, 147-159. doi:10.1037/0882-7974.22.1.147

Isaacowitz, D. M., & Stanley, J. T. (2011). Bringing an ecological perspective to the study of aging and recognition of emotional facial expressions: Past, current, and future methods. *Journal of Nonverbal Behavior*, *35*, 261-278. doi:10.1007/s10919-011-0113-6

Isaacowitz, D. M., Wadlinger, H. A., Goren, D., & Wilson, H. R. (2006a). Is there an age-related positivity effect in visual attention? A comparison of two methodologies. *Emotion*, *6*(3), 511-516.

Isaacowitz, D. M., Wadlinger, H. A., Goren, D., & Wilson, H. R. (2006b). Selective preference in visual fixation away from negative images in old age? An eye-tracking study. *Psychology and Aging*, *21*(1), 40-48.

Jack, R., Blais, C., Scheepers, C., Schyns, P. G., & Caldara, R. (2009) Cultural Confusions Show Facial Expressions are Not Universal. *Current Biology*, *19*, 1543-1548.

Laukka, P., Eerola, T., Thingujam, N. S., Yamasaki, T., & Beller, G. (2013). Universal and culture-specific factors in the recognition and performance of musical affect expressions. *Emotion*, *13*(3), 434-449. doi:10.1037/a0031388

Laukka, P., & Juslin, P. N. (2007). Similar pattern of age-related differences in emotion recognition from speech and music. *Motivation and Emotion*, *31*, 182-191. doi:10.1007/s11031-007-9063-z

Lavoie, M., Callahan, B., Belleville, S., Simard, M., Bier, N., Gagnon, L., Gagnon, J.-F., Blanchet, S., Potvin O., Hudon, C., & Macoir, J. (2013). Normative data for the Dementia Rating Scale in the French-Quebec population. *The Clinical Neuropsychologist, 27*(7), 1150-1166.

Lima, C. F., & Castro, S. L. (2011). Emotion recognition in music changes across the adult life span. *Cognition and Emotion*, *25*, 585-598. doi:10.1080/02699931.2010.502449

Lockenhoff, C. E., & Carstensen, L. L. (2007). Aging, emotion, and health-related decision strategies: Motivational manipulations can reduce age differences. *Psychology and Aging*, *22*(1), 134-146.

Ma, Z., Li, J., Niu, Y., Yu, J., & Yang, L. (2013). Age differences in emotion recognition between Chinese younger and older adults. *The Psychological Record*, *63*(3), 629-640. doi:10.11133/j.tpr.2013.63.3.015

Mather, M., Canli, T., English, T., Whitfield, S., Wais, P., Ochsner, K., John, G., & Carstensen, L., L. (2004). Amygdala responses to emotionally valenced stimuli in older and younger adults. *Psychological Science*, *15*, 259-263.

Mather, M., & Carstensen, L. L. (2005). Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences*, *9*(10), 496-502.

Mattis, S. (1976). Mental status examination for organic mental syndrome in the elderly patient. In L. Bellak, & T. B. Karasu (Eds.), *Geriatric psychiatry* (pp. 77–121). New York: Grune and Stratton.

Mill, A., Allik, J., Realo, A., & Valk, R. (2009). Age-related differences in emotion recognition ability: A cross-sectional study. *Emotion*, *9*(5), 619-630.

Montagne, B., Kessels, R. P. C., De Haan, E. H. F., & Perrett, D. I. (2007). The emotion recognition task: A paradigm to measure the perception of facial emotional expressions at different intensities. *Perceptual and Motor Skills*, *104*, 589-598. doi:10.2466/PMS.104.2.589598

Murphy, F. C., Nimmo-Smith, I., & Lawrence, A. D. (2003). Functional neuroanatomy of emotions: A meta-analysis. *Cognitive, Affective, and Behavioral Neuroscience*, *3*, 207-233.

Naranjo, C., Kornreich, C., Campanella, S., Noël, X., Vandriette,Y., Gillain, B., de Longueville, X., Delatte, B., Verbanck, B., & Constant, E. (2011). Major depression is associated with impaired processing of emotion in music as well as facial and vocal stimuli. *Journal of Affective Disorders*, *128*, 243-251. doi:10.1016/j.jad.2010.06.039

Narme, P., Peretz, I., Strub, M.L., & Ergis, A.M. (2016). The effects of emotion on implicit and explicit musical memory in normal aging. *Psychology and Aging, 31*(8): 902-913.

Ohnishi, T., Matsuda, H., Tabira, T., Asada, T., & Uno, M. (2001). Changes in brain morphology in Alzheimer disease and normal aging: Is Alzheimer disease an exaggerated aging process? *American Journal of Neuroradiology*, *22*, 1680-1685.

Opitz, P. C., Rauch, L. C., Terry, D. P., & Urry, H. L. (2012). Prefrontal mediation of age differences in cognitive reappraisal. *Neurobiology of Aging*, *33*(4), 645-655.

Orgeta, V. (2014). Emotion recognition ability and mild depressive symptoms in late adulthood. *Experimental Aging Research*, *40*(1), 1-12. doi:10.1080/0361073X.2014.857535

Orgeta, V., & Phillips, L. H. (2008). Effects of age and emotional intensity on the recognition of facial emotion. *Experimental Aging Research*, *34*, 63-79. doi:10.1080/03610730701762047

Pearce, M. T., & Halpern, A. R. (2015). Age-related patterns in emotions evoked by music. *Psychology Of Aesthetics, Creativity, And The Arts*, *9*(3), 248-253.

Peretz, I. (2010). Towards a neurobiology of musical emotions. In P. N. Juslin, & J. A. Sloboda (Eds.), *Handbook of music and emotion: Theory, research, applications* (pp. 99-126). New York, NY, US: Oxford University Press.

Petit-Taboué, M. C., Landeau, B., Desson, J. F., Desgranges, B., & Baron, J. C. (1998). Effects of healthy aging on the regional cerebral metabolic rate of glucose assessed with statistical parametric mapping. *NeuroImage*, *7*, 176-184.

Phillips, L. H., MacLean, R. D. J., & Allen, R. (2002). Age and the understanding of emotions: Neuropsychological and sociocognitive perspectives. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, *57*(6), 526-530.

Pillon, B., & Huguonot-Diener, L. (May 2013). Mattis Dementia rating scale. Retrieved from: http://site-greco.net/index.php?pageID=greco_fiche&id=mattis&from=recherche

Punkanen, M., Eerola, T., & Erkkilä, J. (2011). Biased emotional recognition in depression: Perception of emotions in music by depressed patients. *Journal of Affective Disorders*, *130*, 118-126. doi:10.1016/j.jad.2010.10.034

Rapcsak, S. Z., Galper, S. R., Comer, J. F., Reminger, S. L., Nielsen, L., Kaszniak, A. W., Verfaellie, M., Laguna, J. F., Labiner, D. M., & Cohen, R. A. (2000). Fear recognition deficit after focal brain damage: A cautionary note. *Neurology*, *54*, 575-584.

Raven, J., Raven, J. C., & Court, J. H. (1977). *Manual for Raven's progressive matrices and vocabulary scales. Section 3: The standard progressive matrices*. London: H.K. Lewis.

Reed, A. E., & Carstensen, L. L. (2012). The theory behind the age-related positivity effect. *Frontiers In Psychology*, *3*, 339.

Reed, A. E., Chan, L., & Mikels, J. A. (2014). Meta-analysis of the age-related positivity effect: Age differences in preferences for positive over negative information. *Psychology And Aging*, *29*(1), 1-15. doi:10.1037/a0035194

Ruffman, T. (2011). Ecological validity and age-related change in emotion recognition. *Journal of Nonverbal Behavior*, *35*, 297-304. doi:10.1007/s10919-011-0116-3

Ruffman, T., Henry, J. D., Livingstone, V., & Phillips, L. H. (2008). A meta-analytic review of emotion recognition and aging: Implications for neuropsychological models of aging. *Neuroscience and Biobehavioural Reviews*, *32*, 863-881. doi:10.1016/j.neubiorev.2008.01.001

Ruffman, T., Murray, J., Halberstadt, J., & Taumoepeau, M. (2010). Verbosity and emotion recognition in older adults. *Psychology And Aging*, *25*(2), 492-497.

Ruffman, T., Ng, M., & Jenkin, T. (2009). Older Adults Respond Quickly to Angry Faces Despite Labeling Difficulty. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *64B*(2), 171-179. http://doi.org/10.1093/geronb/gbn035

Ruffman, T., Sullivan, S., and Edge, N. (2006). Differences in the way older and younger adults rate threat in faces but not situations. *Journal of Gerontology: Psychological Sciences*, *61*(4), 187–194.

Sheikh, J. I., & Yesavage, J. A. (1986). Geriatric Depression Scale (GDS): Recent evidence and development of a shorter version. *Clinical Gerontologist: The Journal of Aging and Mental Health*, *5*(1-2), 165-173.

Silver, H., & Bilker, W. B. (2015). Colour influences perception of facial emotions but this effect is impaired in healthy ageing and schizophrenia. *Cognitive Neuropsychiatry*, *20*(5), 438-455. doi:10.1080/13546805.2015.1080157

Statistics Canada (2006), A portrait of seniors in Canada. Retrieved from http://www.statcan.gc.ca/pub/89-519-x/89-519-x2006001-eng.pdf

Statistics Canada (2015, September). Canada's population estimates: Age and sex, July 1, 2015. Retrieved from http://www.statcan.gc.ca/daily-quotidien/150929/dq150929b-eng.htm

Sullivan, S., & Ruffman, T. (2004). Emotion recognition deficits in the elderly. *International Journal of Neuroscience*, *114*, 403-432. doi:10.1080/00207450490270901

Sullivan, S., Ruffman, T., & Hutton, S. B. (2007). Age differences in emotion recognition skills and the visual scanning of emotion faces. *Journal of Gerontology: Psychological Sciences*, *62*(1), 53-60.

Sutcliffe, R., Rendell, P. G., Henry, J. D., Bailey, P. E., & Ruffman, T. (2017). Music to my ears: Age-related decline in musical and facial emotion recognition. *Psychology and Aging, 32*(8), 698-709. doi:10.1037/pag0000203

Suzuki, A., & Akiyama, H. (2013). Cognitive aging explains age-related differences in facebased recognition of basic emotions except for anger and disgust. *Aging, Neuropsychology, and Cognition*, *20*, 253-270. doi:10.1080/13825585.2012.692761

Suzuki, A., Hoshino, T., Shigemasu, K., & Kawamura, M. (2007). Decline or improvement?: Age-related differences in facial expression recognition. *Biological Psychology*, *74*, 75-84. doi:10.1016/j.biopsycho.2006.07.003

Vieillard, S., & Bigand, E. (2014). Distinct effects of positive and negative music on older adults' auditory target identification performances. *The Quarterly Journal Of Experimental Psychology*, *67*(11), 2225-2238.

Vieillard, S., Peretz, I., Gosselin, N., Khalfa, S., Gagnon, L., & Bouchard, B. (2008). Happy, sad, scary and peaceful musical excerpts for research on emotions. *Cognition and Emotion*, *22*, 720-752. doi:10.1080/02699930701503567

West, J. T., Horning, S. M., Klebe, K. J., Foster, S. M., Cornwell, R. E., Perret, D., Burt, D. M., & Davis, H. P. (2012). Age effects on emotion recognition in facial displays: From 20 to 89 years of age. *Experimental Aging Research*, *38*, 146-168. doi:10.1080/0361073X.2012.659997

Williams, L. M., Mathersul, D., Palmer, D. M., Gur, R. C., Gur, R. E., & Gordon, E. (2009). Explicit identification and implicit recognition of facial emotions: I. Age effects in males

and females across 10 decades. *Journal of Clinical and Experimental Neuropsychology*, *31*, 257-277. doi:10.1080/13803390802255635

Yesavage, J. A., Brink, T. L., Rose, T. L., & Adey, M. (1986). The geriatric depression rating scale: Comparison with other self-report and psychiatric rating scale. In L. W. Poon (Ed.), *Handbook of clinical memory assessment of older adults* (pp. 153-167).

Zatorre, R. J., & Salimpoor, V. N. (2013) From perception to pleasure: Music and its neural substrates. *Proceedings of the National Academy of Sciences of the United States of America, 110*(Suppl 2), 10430-10437.

Zebrowitz, L. A., Franklin, R. J., Hillman, S., & Boc, H. (2013). Older and younger adults' first impressions from faces: Similar in agreement but different in positivity. *Psychology And Aging*, *28*(1), 202-212. doi:10.1037/a0030927

Table 1

Demographic Characteristics of Participants and Level of General Cognitive Functioning

Characteristics	Elderly Adults (n = 34)	Adults (n = 31)	Difference between Groups (p)
Age	73.29 (6.16)	28.23 (7.71)	–
Gender (number of women)	27	21	0.285
Years of Education	13.71 (3.46)	15.23 (3.33)	0.076
GDS (/15)[a]	1.62 (1.95)	1.84 (2.08)	0.661
General cognitive functioning			
MMS (/100)[b]	96.97 (2.60)	–	–
DRS (/144)[c]	138.94 (2.68)	–	–
Raven (/60)[d]	–	52.10 (5.17)	–

Note. Standard deviations are displayed in parentheses; a = score between 0 and 4 being considered normal (Dias et al., 2017); b = 92.9 (6.4) corresponding to the mean according to age and education (Bravo and Hébert, 1997); c = 139.56 (3.94) corresponding to the mean according to age and education (Lavoie et al., 2013); d = 44 and 33 corresponding to the 50th percentile according to the age of 20 and 50, respectively (Raven et al., 1977).

Table 2

Mean Percentages of Categorization for Each Emotional Category of the Recognition of Facial Emotions Task as a Function of Group

	Participants' Categorization (%)				
Intention	Happiness	Surprise	Sadness	Fear	Anger
Elderly					
Happiness	**98.04** *(6.82)*	0.98	0.98	0.00	0.00
Surprise	0.49	**93.14** *(13.05)*	0.49	5.88	0.00
Sadness	0.00	0.98	**96.08** *(7.18)*	1.96	0.98
Fear	0.00	23.04	0.00	**75.49** *(26.98)*	1.47
Anger	0.00	1.47	0.49	3.43	**94.61** *(10.64)*
Adults					
Happiness	**100.00**	0.00	0.00	0.00	0.00
Surprise	0.00	**98.92** *(4.16)*	0.00	1.08	0.00
Sadness	0.00	0.54	**99.46** *(2.99)*	0.00	0.00
Fear	0.00	11.83	1.08	**87.10** *(12.70)*	0.00
Anger	0.00	0.54	0.00	0.00	**99.46** *(2.99)*

Note. Bold type indicates a match between response and intention. Standard deviations are displayed in parentheses.

Table 3

Mean Percentages of Categorization for Each Emotional Category of the Recognition of Musical Emotions Tasks as a Function of Group

	Participants' Categorization (%)		
Intention	Happiness	Sadness	Fear
Elderly			
Happiness	**98.53** *(4.80)*	1.47	0.00
Sadness	1.47	**95.00** *(8.89)*	3.53
Fear	12.25	10.78	**76.96** *(18.81)*
Adults			
Happiness	**100.00**	0.00	0.00
Sadness	0.00	**100.00**	0.00
Fear	3.23	3.76	**93.01** *(11.00)*

Note. Bold type indicates a match between response and intention. Standard deviations are displayed in parentheses.

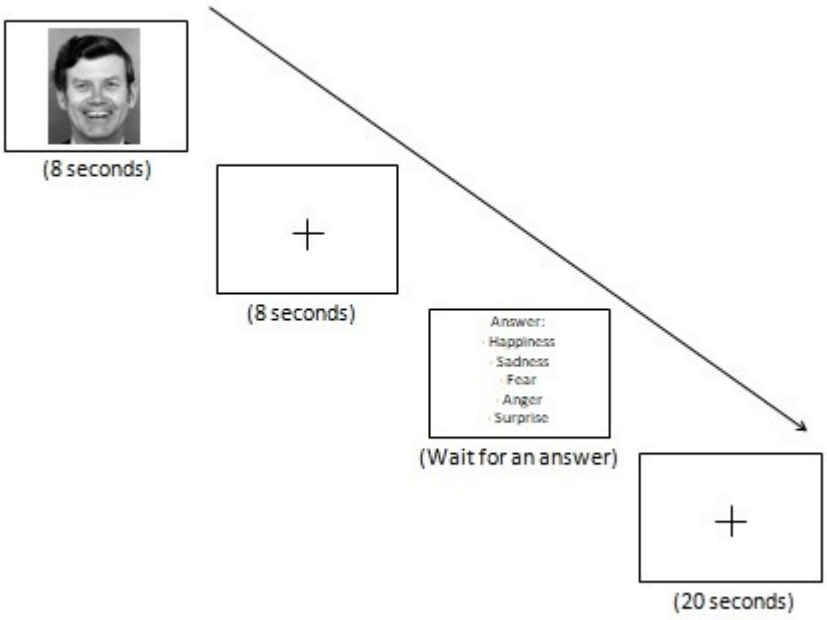

Figure 1. Diagram of the facial task's outline

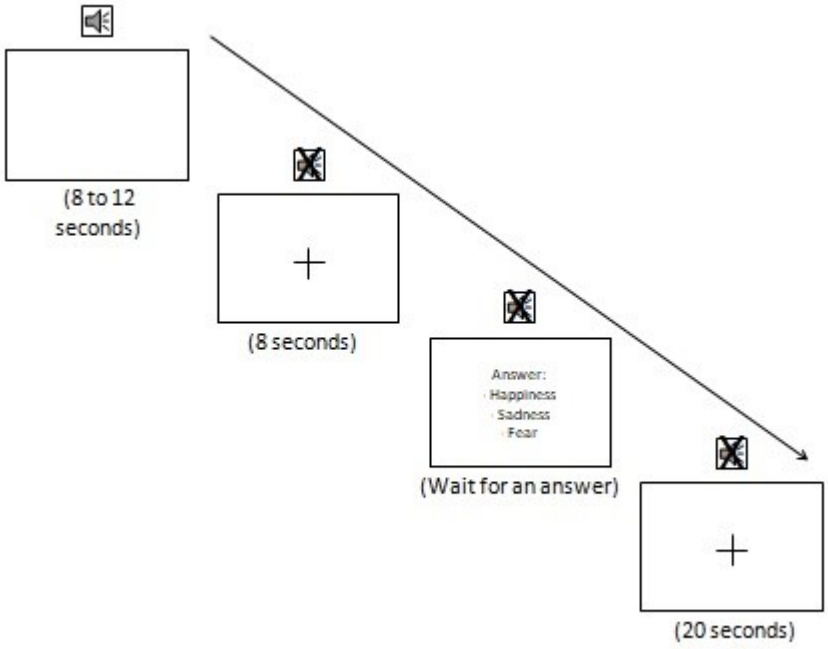

Figure 2. Diagram of the musical task's outline

Conclusion

En résumé, les résultats de cette étude indiquent qu'il existe une différence liée au vieillissement dans la reconnaissance émotionnelle, laquelle varie selon les catégories d'émotion et le médium. À la tâche de catégorisation des émotions faciales, les personnes âgées ont reconnu significativement moins bien que les adultes toutes les catégories d'émotions évaluées (c.-à-d., la joie, la tristesse, la peur, la colère et la surprise). Comme la reconnaissance des stimuli à valence positive (les expressions faciales de joie) n'est pas mieux préservée que ceux valence négative (les expressions faciales de tristesse, de peur et de colère), ces résultats sont peu compatibles avec la présence d'un biais positif lié au vieillissement. Ces résultats à la tâche de catégorisation d'émotions faciales pourraient cependant être compatibles avec la théorie neurologique. En effet, cette théorie postule que les écarts liés à l'âge dans la reconnaissance émotionnelle seraient dus au déclin naturel de structures du cerveau liées à la reconnaissance émotionnelle (voir Ruffman et al., 2008). Par exemple, l'amygdale, qui s'atrophie de manière linéaire avec l'âge (Allen et al., 2005), est associée à la reconnaissance de la joie, de la tristesse, de la peur, de la colère et de la surprise (Blair et al., 1999; Breiter et al., 1996; Davis & Whalen, 2001; Gosselin et al., 2011; Mattavelli et al., 2014; Zhao et al., 2017; Ziaei et al., 2016).

Deuxièmement, il a été trouvé que les personnes âgées reconnaissent significativement moins bien que les adultes la tristesse et la peur exprimées par la musique. Toutefois, les deux groupes d'âge reconnaissent de manière similaire la joie exprimée par la musique. Ces résultats appuient donc la possibilité de la présence d'un biais positif lié à l'âge, lequel pourrait potentiellement être expliqué par la théorie socioémotionnelle. Cette dernière propose que la

perception du temps qui s'écoule module les motivations des individus (Carstensen, 2006; Carstensen et al., 1999), les poussant à favoriser les informations positives plutôt que négatives (Carstensen & Mikels, 2005; Mather & Carstensen, 2005), afin de régulariser leurs émotions, ainsi que de maintenir des affects positifs et des relations interpersonnelles positives (Carstensen et al., 2003; Liao & Carstensen, 2018; Löckenhoff & Carstensen, 2004; Mather & Carstensen, 2005). Le déclin de la reconnaissance de la peur et de la tristesse exprimées par la musique est aussi compatible avec la théorie neurologique, puisque celle-ci propose que les différences liées à l'âge dans la reconnaissance émotionnelle soient dues au déclin de régions cérébrales liées à la reconnaissance d'émotions spécifiques. Par exemple, l'amygdale, dont le volume s'atrophie linéairement avec l'âge (Allen et al., 2005), est liée à la reconnaissance de la peur exprimée par la musique (Gosselin et al., 2005, 2007, 2011). En sommes, l'ensemble des résultats de cette étude corroborent en partie la théorie socioémotionnelle et la théorie neurologique.

La présente étude contribue à la compréhension de l'effet du vieillissement sur la reconnaissance des émotions en évaluant les deux médiums (visages et musique) au sein des mêmes groupes de participants (personnes âgées et adultes), ce qui permet de réduire l'influence des différences individuelles. Auparavant, seulement deux autres études avaient évalué la reconnaissance émotionnelle du visage et de la musique auprès d'un même groupe de participant (Brosgole, & Weisman, 1995; Sutcliffe et al., 2017). La présente étude permet également de pallier certaines lacunes de ces études, par exemple en contrôlant pour les symptômes dépressifs.

Toutefois, cette étude comporte des limites. La présence d'effets plafonds dans le groupe des adultes tend à indiquer un manque de sensibilité des tâches. Ceci pourrait expliquer en partie l'absence de biais positif lié à l'âge pour les visages, alors que ce biais est généralement trouvé dans la littérature (Reed et al., 2014; Ruffman et al., 2008). De plus, la sensibilité des stimuli

varie selon la catégorie émotionnelle (p. ex. la reconnaissance de la joie est caractérisée par un effet plafond, mais pas celle de la peur). Ceci concorde avec la littérature qui décrit la peur comme étant une des émotions les plus difficiles à reconnaître (Montagne, Kessels, De Haan, & Perrett, 2007; Rapcsak et al., 2000; West et al., 2012) et la joie comme étant la plus facile à reconnaître (Chiu et al., 2015; Horning et al., 2012; Montagne et al., 2007). Comme c'est le cas dans la présente étude, la reconnaissance de la joie est conséquemment souvent caractérisée par des effets plafonds dans la littérature (Ruffman et al., 2008). Afin de pallier cette limite, il serait intéressant pour les études futures d'utiliser des stimuli moins saillants. Par exemple, pour les visages, Hess, Blairy et Kleck (1997) ont utilisé un logiciel de *morphing* qui combine graduellement deux photographies du même visage (au neutre et exprimant une émotion), afin de réduire l'intensité émotionnelle de visages exprimant la joie, la tristesse, la colère ou le dégoût. Ils ont d'ailleurs trouvé que la reconnaissance émotionnelle décline linéairement avec la réduction de l'intensité émotionnelle (Hess et al., 1997).

De plus, dans la présente étude, le groupe des jeunes adultes comprend des participants allant jusqu'à 50 ans. Or, étant donné que des études rapportent une diminution linéaire de la reconnaissance de la peur débutant vers l'âge de 40 ans (Calder et al., 2003; 60 ans selon West et al., 2012), il serait préférable pour les prochaines études de recruter des groupes de participants plus distancés en âge. À ce sujet, la peur a été moins bien reconnue que les autres émotions par les deux groupes d'âge, pour les deux médiums. Cependant, le protocole ne permet pas de statuer sur la ou les causes pouvant expliquer ces observations. Des études futures seront nécessaires afin de clarifier le rôle de l'amygdale dans cette disparité.

Il serait aussi pertinent pour les études futures d'inclure une mesure de positivité, afin d'éclaircir la relation entre les changements liés à l'âge dans la reconnaissance émotionnelle et le biais positif des personnes âgées. Par exemple, l'échelle de positivité (Caprara et al., 2012) est un questionnaire rapide comprenant huit items (p. ex., « J'ai une grande confiance en l'avenir » et « Je suis satisfait(e) de ma vie ») qui est complété avec une échelle de type Likert, allant de 1 (fortement en désaccord) à 5 (fortement en accord). Le score total à ce questionnaire représente une mesure de la positivité d'un individu (c.-à-d. qu'un score élevé indique une positivité élevée), donc de sa tendance à percevoir la vie et ses expériences positivement (Caprara et al., 2012). Ainsi, cette mesure pourrait possiblement permettre d'affirmer avec plus d'assurance si l'effet de l'âge sur la reconnaissance émotionnelle est associé ou non à une tendance des personnes âgées vers des perceptions positives. Aussi, comme la présente étude est transversale, nous ne pouvons pas exclure qu'un effet de cohorte ait pu influencer les résultats. À cette fin, des études longitudinales sur des échantillons plus grands seraient nécessaires.

Comme la population est vieillissante et que des difficultés à reconnaître adéquatement les émotions de base peuvent entraîner une augmentation des symptômes dépressifs (Carton et al., 1999), il semble primordial de continuer la recherche dans ce domaine.

Bibliographie

Adolphs, R. (2008). Fear, Faces, and the Human Amygdala. *Current Opinion in Neurobiology*, *18*(2), 166-172.

Adolphs, R., & Tranel, D. (2004). Impaired judgments of sadness but not happiness following bilateral amygdala damage. *Journal of Cognitive Neuroscience, 16*(3), 453-462. doi:10.1162/089892904322926782

Adolphs, R., Tranel, D., Damasio, H., & Damasio, A. (1994). Impaired recognition of emotion in facial expressions following bilateral damage to the human amygdala. *Nature*, *372*, 669-672.

Adolphs, R., Tranel, D., Hamann, S., Young, A. W., Calder, A. J., Phelps, E. A., Anderson, A., Lee, G. P., & Damasio, A. R. (1999). Recognition of facial emotion in nine individuals with bilateral amygdala damage. *Neuropsychologia, 37*(10), 1111-1117. doi:10.1016/S0028-3932(99)00039-1

Allen, R., & Brosgole, L. (1993). Facial and auditory affect recognition in senile geriatrics, the normal elderly and young adults. *International Journal of Neuroscience*, *68*(1-2), 33-42.

Allen, J. S., Bruss, J., Brown, C. K., & Damasio, H. (2005). Normal neuroanatomical variation due to age: The major lobes and parcellation of the temporal region. *Neurobiology of Aging*, *26*, 1245-1260. doi:10.1016/j.neurobiolaging.2005.05.023

Beer, J. M., Smarr, C., Fisk, A. D., & Rogers, W. A. (2015). Younger and older users' recognition of virtual agent facial expressions. *International Journal Of Human-Computer Studies*, *75*, 1-20. doi:10.1016/j.ijhcs.2014.11.005

Biehl, M., Matsumoto, D., Ekman, P., Hearn, V., Heider, K., Kudoh, T., & Ton, V. (1997). Matsumoto and Ekman's Japanese and Caucasian Facial Expressions of Emotion (JACFEE): Reliability Data and Cross-National Differences. *Journal of Nonverbal Behavior*, *21*(1), 3-21. doi:10.1023/a:1024902500935

Blais, C., Jack, R. E., Scheepers, C., Fiset, D., & Caldara, R. (2008) Culture shapes how we look at faces. *PLoS one*, *3*(8), e3022. doi:10.1371/journal.pone.0003022

Blair, R. J. R., Morris, J. S., Frith, C. D., Perrett, D. I., & Dolan, R. J. (1999). Dissociable neural responses to facial expressions of sadness and anger. *Brain*, *122*, 883-893.

Breiter, H. C., Etcoff, N. L., Whalen, P. J., Kennedy, W. A., Rauch, S. L., Buckner, R. L., Strauss, M. M., Hyman, S. E., & Rosen, B. R. (1996). Response and Habituation of the

Human Amygdala during Visual Processing of Facial Expression. *Neuron, 17*(5), 875-887. doi:https://doi.org/10.1016/S0896-6273(00)80219-6

Brosgole L., & Weisman, J. (1995) Mood recognition across the ages. *International Journal of Neuroscience*, *82*(3-4), 169-189.

Calder, A. J., Keane, J., Manly, T., Sprengelmeyer, R., Scott, S., Nimmo-Smith, I., & Young, A. W. (2003). Facial expression recognition across the adult life span. *Neuropsychologia*, *41*, 195-202.

Caprara, G. V., Alessandri, G., Eisenberg, N., Kupfer, A., Steca, P., Caprara, M. G., Yamaguchi, S., Fukuzawa, A., & Abela, J. (2012). The Positivity Scale. *Psychological Assessment*, *24*(3), 701-712.

Carstensen, L. L. (1993). Motivation for social contact across the life span: A theory of socioemotional selectivity. In *Nebraska Symposium on Motivation, 1992: Developmental perspectives on motivation.* (pp. 209-254). Lincoln, NE, US: University of Nebraska Press.

Carstensen, L. L. (2006). The Influence of a Sense of Time on Human Development. *Science*, *312*(5782), 1913-1915.

Carstensen, L. L., Fung, H. H., & Charles, S. T. (2003). Socioemotional selectivity theory and the regulation of emotion in the second half of life. *Motivation And Emotion*, *27*(2), 103-123. doi:10.1023/A:1024569803230

Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*, *54*(3), 165-181. doi:10.1037/0003-066X.54.3.165

Carstensen, L. L., & Mikels, J. A. (2005). At the Intersection of Emotion and Cognition: Aging and the Positivity Effect. *Current Directions In Psychological Science*, *14*(3), 117-121.

Carton, J. S., Kessler, E. A., & Pape, C. L. (1999). Nonverbal decoding skills and relationship well-being in adults. *Journal of Nonverbal Behavior*, *23*, 91-100. doi:10.1023/A:1021339410262

Castro, S. L., & Lima, C. F. (2014). Age and musical expertise influence emotion recognition in music. *Music Perception*, *32*(2), 125-142. doi:10.1525/mp.2014.32.2.125

Chaby, L., Luherne-du Boullay, V. L., Chetouani, M., & Plaza, M. (2015). Compensating for age limits through emotional crossmodal integration. *Frontiers In Psychology*, *6*, 691.

Charles, S. T., Mather, M., & Carstensen, L. L. (2003). Aging and emotional memory: The forgettable nature of negative images for older adults. *Journal of Experimental Psychology-General*, *132*(2), 310-324.

Chiu, I., Gfrörer, R. I., Piguet, O., Berres, M., Monsch, A. U., & Sollberger, M. (2015). 'Now I see it, now I don't': Determining threshold levels of facial emotion recognition for use in patient populations. *Journal Of The International Neuropsychological Society*, *21*(7), 568-572. doi:10.1017/S1355617715000557

Circelli, K. S., Clark, U. S., & Cronin-Golomb, A. (2013). Visual scanning patterns and executive function in relation to facial emotion recognition in aging. *Aging, Neuropsychology, And Cognition*, *20*(2), 148-173.

Davis, M., & Whalen, P. J. (2001). The amygdala: vigilance and emotion. *Molecular Psychiatry, 6*(1), 13-34.

Drapeau, J., Gosselin, N., Gagnon, L., Peretz, I., & Lorrain, D. (2009). Emotional recognition from face, voice and music in dementia of Alzheimer type: Implication for music therapy. *The Neurosciences and Music III: Disorders and Plasticity*, *1169*, 342-345. doi:10.1111/j.1749-6632.2009.04768.x

Ekman, P. (1970). Universal facial expressions of emotion. *California Mental Health Research Digest, 8*(4), 151-158.

Ekman, P. (2017) Facial Expressions. Dans J. M. Fernández-Dols et J. A. Russell (dir.). (2017). *The science of facial expression*. New York, NY: Oxford University Press.

Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology, 17*(2), 124-129. doi:10.1037/h0030377

Ekman, P., Friesen, W. V., & Ellsworth, P. (1972). *Emotion in the human face: Guidelines for research and an integration of findings*. Oxford, England: Pergamon Press.

Fung, H. H., & Carstensen, L. L. (2003). Sending memorable messages to the old: Age differences in preferences and memory for advertisements. *Journal of Personality and Social Psychology, 85*(1), 163-178. doi:10.1037/0022-3514.85.1.163

Gagnon, L., Gosselin, N., Provencher, V., & Bier, N. (2012). Perception and emotional judgments of music in dementia of the Alzheimer type: A short case study. *Music Perception*, *29*, 509-519. doi:10.1525/mp.2012.29.5.509

Gosselin, N., Peretz, I., Hasboun, D., Baulac, M., & Samson, S. (2011). Impaired recognition of musical emotions and facial expressions following anteromedial temporal lobe excision. *Cortex*, *47*, 1116-1125. doi:10.1016/j.cortex.2011.05.012

Gosselin, N., Peretz, I., Johnsen, E., & Adolphs, R. (2007). Amygdala damage impairs emotion recognition from music. *Neuropsychologia*, *45*, 236-244. doi:10.1016/j.neuropsychologia.2006.07.012

Gosselin, N., Peretz, I., Noulhiane, M., Hasboun, D., Beckett, C., Baulac, M., & Samson, S. (2005). Impaired recognition of scary music following unilateral temporal lobe excision. *Brain*, *128*, 628-640. doi:10.1093/brain/awh420

Hailstone, J. C., Omar, R., Henley, S. M., Frost, C., Kenward, M. G., & Warren, J. D. (2009). It's not what you play, it's how you play it: timbre affects perception of emotion in music. *The Quarterly Journal of Experimental Psychology, 62*(11), 2141-2155. doi:10.1080/17470210902765957

Halberstadt, J., Ruffman, T., Murray, J., Taumoepeau, M., & Ryan, M. (2011). Emotion perception explains age-related differences in the perception of social gaffes. *Psychology and Aging*, *26*, 133-136. doi:10.1037/a0021366

Henry, J. D., Ruffman, T., McDonald, S., Peek O'Leary, M.-A., Phillips, L. H., Brodaty, H., & Rendell, P. G. (2008). Recognition of disgust is selectively preserved in Alzheimer's disease. *Neuropsychologia*, *46*, 1363-1370.

Hess, U., Blairy, S., & Kleck, R. E. (1997). The intensity of emotional facial expressions and decoding accuracy. *Journal of Nonverbal Behavior*, *21*(4), 241-257.

Horning, S. M., Cornwell, R. E., & Davis, H. P. (2012). The recognition of facial expressions: An investigation of the influence of age and cognition. *Aging, Neuropsychology, and Cognitio*n, *19*, 657-676. doi:10.1080/13825585.2011.645011

Hot, P., Klein-Koerkamp, Y., Borg, C., Richard-Mornas, A., Zsoldos, I., Paignon, A., Thomas Antérion, C., & Baciu, M. (2013). Fear recognition impairment in early-stage Alzheimer's disease: When focusing on the eyes region improves performance. *Brain and Cognition*, *82*, 25-34. doi:10.1016/j.bandc.2013.02.001

Jack, R., Blais, C., Scheepers, C., Schyns, P. G., & Caldara, R. (2009) Cultural Confusions Show Facial Expressions are Not Universal. *Current Biology*, *19*, 1543-1548.

Jehna, M., Neuper, C., Ischebeck, A., Loitfelder, M., Ropele, S., Langkammer, C., Lebner, F., Fuchs, S., Schmidt, Fazekas, F., & Enzinger, C. (2011) The functional correlates of face perception and recognition of emotional facial expressions as evidenced by fMRI. *Brain Research, 1393*, 73-83.

Juslin, P. N., & Västfjäll, D. (2008). Emotional responses to music: The need to consider underlying mechanisms. *Behavioral and Brain Sciences*, *31*(5), 559-621. doi:10.1017/S0140525X08005293

Keltner, D., & Kring, A. M. (1998). Emotion, social function, and psychopathology. *Review of General Psychology, 2*(3), 320-342. doi:10.1037/1089-2680.2.3.320

Laukka, P., Eerola, T., Thingujam, N. S., Yamasaki, T., & Beller, G. (2013). Universal and culture-specific factors in the recognition and performance of musical affect expressions. *Emotion*, *13*(3), 434-449. doi:10.1037/a0031388

Laukka, P., & Juslin, P. N. (2007). Similar pattern of age-related differences in emotion recognition from speech and music. *Motivation and Emotion*, *31*, 182-191. doi:10.1007/s11031-007-9063-z

Liao, H.-W., & Carstensen, L. L. (2018). Future time perspective: Time horizons and beyond. *GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry, 31*(3), 163-167. doi:10.1024/1662-9647/a000194

Lima, C. F., & Castro, S. L. (2011). Emotion recognition in music changes across the adult life span. *Cognition and Emotion*, *25*, 585-598. doi:10.1080/02699931.2010.502449

Löckenhoff, C. E., & Carstensen, L. L. (2004). Socioemotional selectivity theory, aging, and health: The increasingly delicate balance between regulating emotions and making tough choices. *Journal of Personality, 72*(6), 1395-1424. doi:10.1111/j.1467-6494.2004.00301.x

Ma, Z., Li, J., Niu, Y., Yu, J., & Yang, L. (2013). Age differences in emotion recognition between Chinese younger and older adults. *The Psychological Record*, *63*(3), 629-640. doi:10.11133/j.tpr.2013.63.3.015

Mather, M., & Carstensen, L. L. (2005). Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences*, *9*(10), 496-502.

Mattavelli, G., Sormaz, M., Flack, T., Asghar, A. U. R., Fan, S., Frey, J., Manssuer, L., Usten, D., Youn, . W., & Andrews, T. J. (2014). Neural responses to facial expressions support the role of the amygdala in processing threat. *Social Cognitive and Affective Neuroscience, 9*(11), 1684-1689. doi:10.1093/scan/nst162

Montagne, B., Kessels, R. P. C., De Haan, E. H. F., & Perrett, D. I. (2007). The emotion recognition task: A paradigm to measure the perception of facial emotional expressions at different intensities. *Perceptual and Motor Skills*, *104*, 589-598. doi:10.2466/PMS.104.2.589598

Morris, J. S., Frith, C. D., Perrett, D. I., Rowland, D., Young, A. W., Calder, A. J., & Dolan, R. J. (1996). A differential neural response in the human amygdala to fearful and happy facial expressions. *Nature, 383*(6603), 812-815. doi:10.1038/383812a0

Murphy, F. C., Nimmo-Smith, I., & Lawrence, A. D. (2003). Functional neuroanatomy of emotions: A meta-analysis. *Cognitive, Affective, and Behavioral Neuroscience*, *3*, 207-233.

Naranjo, C., Kornreich, C., Campanella, S., Noël, X., Vandriette,Y., Gillain, B., de Longueville, X., Delatte, B., Verbanck, B., & Constant, E. (2011). Major depression is associated with impaired processing of emotion in music as well as facial and vocal stimuli. *Journal of Affective Disorders*, *128*, 243-251. doi:10.1016/j.jad.2010.06.039

Ohnishi, T., Matsuda, H., Tabira, T., Asada, T., & Uno, M. (2001). Changes in brain morphology in Alzheimer disease and normal aging: Is Alzheimer disease an exaggerated aging process? *American Journal of Neuroradiology*, *22*, 1680-1685.

Orgeta, V. (2014). Emotion recognition ability and mild depressive symptoms in late adulthood. *Experimental Aging Research*, *40*(1), 1-12. doi:10.1080/0361073X.2014.857535

Orgeta, V., & Phillips, L. H. (2008). Effects of age and emotional intensity on the recognition of facial emotion. *Experimental Aging Research*, *34*, 63-79. doi:10.1080/03610730701762047

Peretz, I. (2010). Towards a neurobiology of musical emotions. In P. N. Juslin, & J. A. Sloboda (Eds.), *Handbook of music and emotion: Theory, research, applications* (pp. 99-126). New York, NY, US: Oxford University Press.

Petit-Taboué, M. C., Landeau, B., Desson, J. F., Desgranges, B., & Baron, J. C. (1998). Effects of healthy aging on the regional cerebral metabolic rate of glucose assessed with statistical parametric mapping. *NeuroImage*, *7*, 176-184.

Punkanen, M., Eerola, T., & Erkkilä, J. (2011). Biased emotional recognition in depression: Perception of emotions in music by depressed patients. *Journal of Affective Disorders*, *130*, 118-126. doi:10.1016/j.jad.2010.10.034

Rapcsak, S. Z., Galper, S. R., Comer, J. F., Reminger, S. L., Nielsen, L., Kaszniak, A. W., Verfaellie, M., Laguna, J. F., Labiner, D. M., & Cohen, R. A. (2000). Fear recognition deficit after focal brain damage: A cautionary note. *Neurology*, *54*, 575-584.

Reed, A. E., & Carstensen, L. L. (2012). The theory behind the age-related positivity effect. *Frontiers In Psychology*, *3*, 339.

Reed, A. E., Chan, L., & Mikels, J. A. (2014). Meta-analysis of the age-related positivity effect: Age differences in preferences for positive over negative information. *Psychology And Aging*, *29*(1), 1-15. doi:10.1037/a0035194

Ruffman, T., Henry, J. D., Livingstone, V., & Phillips, L. H. (2008). A meta-analytic review of emotion recognition and aging: Implications for neuropsychological models of aging. *Neuroscience and Biobehavioural Reviews*, *32*, 863-881. doi:10.1016/j.neubiorev.2008.01.001

Ruffman, T., Ng, M., & Jenkin, T. (2009). Older Adults Respond Quickly to Angry Faces Despite Labeling Difficulty. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *64B*(2), 171-179. http://doi.org/10.1093/geronb/gbn035

Statistics Canada (2015, September). Canada's population estimates: Age and sex, July 1, 2015. Retrieved from http://www.statcan.gc.ca/daily-quotidien/150929/dq150929b-eng.htm.

Sutcliffe, R., Rendell, P. G., Henry, J. D., Bailey, P. E., & Ruffman, T. (2017). Music to my ears: Age-related decline in musical and facial emotion recognition. *Psychology and Aging, 32*(8), 698-709. doi:10.1037/pag0000203

Suzuki, A., & Akiyama, H. (2013). Cognitive aging explains age-related differences in facebased recognition of basic emotions except for anger and disgust. *Aging, Neuropsychology, and Cognition*, *20*, 253-270. doi:10.1080/13825585.2012.692761

Vieillard, S., Peretz, I., Gosselin, N., Khalfa, S., Gagnon, L., & Bouchard, B. (2008). Happy, sad, scary and peaceful musical excerpts for research on emotions. *Cognition and Emotion*, *22*, 720-752. doi:10.1080/02699930701503567

Voelkle, M. C., Ebner, N. C., Lindenberger, U., & Riediger, M. (2014). A note on age differences in mood-congruent vs. mood-incongruent emotion processing in faces. *Frontiers In Psychology*, *5*, 635. doi:10.3389/fpsyg.2014.00635

West, J. T., Horning, S. M., Klebe, K. J., Foster, S. M., Cornwell, R. E., Perret, D., Burt, D. M., & Davis, H. P. (2012). Age effects on emotion recognition in facial displays: From 20 to 89 years of age. *Experimental Aging Research*, *38*, 146-168. doi:10.1080/0361073X.2012.659997

Williams, L. M., Brown, K. J., Palmer, D., Liddell, B. J., Kemp, A. H., Olivieri, G., Peduto, A., & Gordon, E. (2006). The mellow years?: neural basis of improving emotional stability over age. *The Journal of Neuroscience, 26*(24), 6422-6430. doi:10.1523/JNEUROSCI.0022-06.2006

Williams, L. M., Mathersul, D., Palmer, D. M., Gur, R. C., Gur, R. E., & Gordon, E. (2009). Explicit identification and implicit recognition of facial emotions: I. Age effects in males and females across 10 decades. *Journal of Clinical and Experimental Neuropsychology*, *31*, 257-277. doi:10.1080/13803390802255635

Zhao, K., Zhao, J., Zhang, M., Cui, Q., & Fu, X. (2017). Neural Responses to Rapid Facial Expressions of Fear and Surprise. *Frontiers In Psychology, 8*, 761. doi:10.3389/fpsyg.2017.00761

Ziaei, M., Burianová, H., von Hippel, W., Ebner, N. C., Phillips, L. H., & Henry, J. D. (2016). The impact of aging on the neural networks involved in gaze and emotional processing. *Neurobiology of Aging, 48*, 182-194. doi:10.1016/j.neurobiolaging.2016.08.026