Effets de la dynamique temporelle sur le jugement de l'authenticité du sourire

David Asselin

Thèse soumise dans le cadre des exigences du programme de Doctorat en Psychologie Expérimentale

École de Psychology

Faculté des Sciences sociales

Université d'Ottawa

Université d'Ottawa

École de Psychologie

Résumé

La capacité à exprimer autre chose sur le visage que l'expression faciale associée à l'émotion qui est ressentie n'est apparue que relativement tard dans la grande histoire de l'être humain. Alors que cette concordance était directe à l'aube de l'évolution humaine, elle aurait par la suite évolué en raison des bénéfices sociaux qu'elle procure à celui qui émet l'expression faciale. Encore aujourd'hui, la littérature nous donne un portrait nuancé sur le lien qui existe entre l'émotion ressentie et son expression faciale. D'un côté, plusieurs études nous indiquent qu'il existe une concordance entre ces deux processus (Gosselin, Kirouac, & Dore, 1995; Rosenberg & Ekman, 1994; Ruch, 1995) alors que de l'autre nous savons aussi que l'expression faciale peut très bien être contrôlée et trompeuse (O'Sullivan et al., 1988, Ekman, 1993; 2003). Il existe différents indices qui nous permettent de distinguer entre une expression faciale authentique et une expression faciale fausse. Parmi ceux-ci figurent les unités d'action faciale qui sont activées sur le visage lors de l'expression faciale, leur symétrie et leur dynamique temporelle, toutes mesurées à l'aide du Facial Action Coding System (Ekman & Friesen, 1978; Ekman, Friesen & Hager, 2002). L'objectif principal de cette thèse sera d'évaluer la sensibilité de l'être humain à la dynamique temporelle du sourire, ainsi que son effet sur le jugement d'authenticité. Les résultats des études 1 à 3 indiquent que les participants sont bien sensibles à la dynamique temporelle, et qu'ils l'utilisent pour juger correctement l'authenticité du sourire, du moins lorsque la durée des phases de relâchement, ou les phases d'amorce et de relâchement simultanément varie. Nos participants ne semblent pas utiliser la dynamique temporelle pour juger de l'authenticité du sourire même s'ils sont en mesure de bien juger les différences temporelles dans la phase d'amorce. L'étude 4 a été réalisée afin de valider la méthode de fabrication des stimuli utilisée dans les études précédente, et confirme que celle-ci n'a pas eu d'effet sur les résultats. Enfin,

l'étude 5 a été réalisée dans le but d'examiner davantage le lien unissant la dynamique temporelle au jugement d'authenticité grâce à deux tâches de jugement; La première voulant examiner le jugement de la durée de sourires, alors que la seconde examine le jugement de l'authenticité. Plutôt que d'utiliser une échelle de type Likert telle que dans les études 1 et 4, nous avons opté pour une méthode d'estimation de la magnitude, dans le but d'examiner les habiletés de manière intra individuelles de nos participants. Celle-ci montre qu'au niveau individuel, les participants qui arrivent à mieux juger les changements dans la durée des phases du sourire n'arrivent pas nécessairement à mieux juger l'authenticité du sourire. Dans leur ensemble, nos résultats contribuent à la compréhension que nous avons du lien unissant la dynamique temporelle et le jugement de l'authenticité du sourire, et permettent de solidifier la fondation empirique sur lequel pourront construire les études futures du domaine.

Préface

Cette thèse comporte un ensemble de cinq études, dont la première (chapitre 2) a été publiée dans le journal *Attention, Perception et Psychophysics* en 2020 avec la collaboration de Dr. Charles Collin et Dre Patricia Brosseau-Liard, et un manuscrit incluant les études 2 et 3 (chapitre 3 et 4), lequel est en cours de préparation pour soumission. Certaines parties ont été modifiées ou enlevées afin d'éviter la répétition. Les chapitres 5 à 7 ont été rédigé sous forme de monographie. Certaines parties de cette thèse ont été rédigées en français, et d'autres en anglais puisqu'il s'agit d'un travail qui s'est échelonné sur plusieurs années.

L'ensemble de la conception des études, la construction de la banque de stimuli utilisée pour les cinq études, la récolte des données, et l'analyse des données a été réalisé par David Asselin.

Ce projet de recherche a été subventionné par le Conseil de recherches en Sciences Humaines du Canada et le Fond de recherche Société et Culture.

Remerciements

Je tiens à remercier tous les membres de mon comité de thèse, Cary Kogan, Denis Cousineau, Sylvain Chartier et Daniel Fiset qui m'ont aidé à l'élaboration de cette thèse grâce à leurs contributions par leur questions et commentaires toujours pertinents.

Je veux aussi remercier tout particulièrement mes superviseurs Charles Collin et Patricia Brosseau-Liard qui, de par leur dévouement, leur patience, leur générosité et leur organisation m'ont épaulé tout au long du processus de rédaction de ma thèse. Je tiens aussi à remercier Pierre Gosselin qui m'a grandement aidé lors de mes premières années au programme de Doctorat à devenir un chercheur rigoureux. J'aimerais aussi remercier Eveline Bruck, ancienne étudiante au programme de psychologie de l'université d'Ottawa, et bénévole au laboratoire, qui m'a aidé à récolter les données pour l'étude 4 de cette thèse.

Enfin, je tiens à remercier ma famille, et particulièrement ma conjointe, Tanya et mon frère, Paolo, qui m'ont encouragé à persévérer dans les moments difficiles.

Je n'aurais pu terminer ce projet de recherche sans l'aide de toutes ces personnes, qui chacune à leur façon, m'ont permis de devenir un meilleur chercheur et une meilleure personne.

Table des matières

Liste des figures

Liste des tableaux

Chapitre 1 : Introduction générale

Authenticité du sourire

Il est très ancré dans la croyance populaire que le visage est le miroir de l'âme ; que le comportement du visage est le reflet des états émotionnels ressentis. Cette croyance s'est renforcée depuis la publication, en 1872, du livre de Charles Darwin, intitulé « L'expression des émotions chez l'homme et les animaux ». Quoique la recherche effectuée depuis par un grand nombre de chercheurs sur le sujet supporte une partie de cette affirmation, il serait erroné de la généraliser. En fait, la réalité est beaucoup plus nuancée. Les émotions ne sont pas toujours reflétées par l'entremise de l'activité faciale et, bien que plusieurs études indiquent qu'il puisse y avoir une concordance entre l'émotion ressentie et l'expression faciale (Gosselin, Kirouac, & Dore, 1995; Rosenberg & Ekman, 1994; Ruch, 1995), cette dernière peut tout aussi être contrôlée. Ekman (1993; 2003) a proposé à ce sujet plusieurs stratégies de contrôle : la simulation, l'atténuation et l'amplification, la neutralisation, et le masquage. D'abord, la simulation consiste à simuler délibérément une expression qui est normalement associée à une émotion sans qu'elle ne soit réellement ressentie par l'individu. Cette stratégie est utilisée pour cacher le fait que l'émotion normalement attendue ne soit pas ressentie par l'individu. Ensuite, un individu peut diminuer ou à, l'inverse, augmenter volontairement l'intensité de l'expression de l'émotion ressentie. Une personne peut aussi simplement neutraliser l'expression de l'émotion, ce qui fait en sorte que l'on ne retrouve pas de traces de l'émotion ressentie dans l'expression du visage. Enfin, l'individu peut masquer l'expression d'une émotion ressentie par l'expression d'une autre émotion.

Parmi les différentes expressions émotionnelles, le sourire joue un rôle particulièrement important dans la régulation des interactions sociales. Selon Owren et Bachorowski (2001), le

sourire renforcerait les sentiments positifs entre les partenaires d'une interaction et favoriserait l'émission d'un traitement favorable ainsi que les activités de coopération. Ces auteurs postulent que le sourire exprimé par l'émetteur aurait la propriété d'induire un état émotionnel positif chez le récepteur qui, à son tour, sourirait. Cette rétroaction positive serait récursive et renforcerait les liens d'attachement entre les partenaires. Pendant une certaine période de l'évolution des hominiens, il y aurait toujours eu concordance entre l'expérience de la joie et l'émission du sourire. Cependant, dans une période ultérieure, les hominiens auraient acquis la capacité de sourire intentionnellement et il n'y aurait pas toujours eu concordance entre l'expérience de la joie et l'émission du sourire. Cette nouvelle capacité aurait émergé en raison des bénéfices que procurait le sourire à l'émetteur : celui de rendre plus probable un traitement favorable de la part d'un autre congénère.

Dans le cadre de cette thèse, nous utiliserons le terme *sourire authentique* pour désigner le sourire produit par une personne lorsqu'elle est contente et qu'elle l'exprime ouvertement et le terme *sourire faux* pour désigner le sourire produit intentionnellement par une personne lorsqu'elle veut faire croire qu'elle est contente alors qu'elle ne ressent pas de joie. Ce sont les termes français qui se rapprochent le plus des termes *genuine smile* et *false smile* utilisés par les chercheurs dans la langue anglaise. Il est à noter que d'autres termes ont été utilisés, comme sourire spontané (spontaneous smile) et sourire simulé (simulated smile), mais pas aussi souvent que les premiers.

Différences entre les sourires authentiques et faux

Les travaux de recherche effectués au cours des trois dernières décennies ont permis d'identifier plusieurs différences entre les sourire authentiques et faux. Elles concernent le type d'unités d'action faciale qui sont activées, leur symétrie et leur dynamique temporelle. Dans la prochaine section, nous décrivons dans quel contexte expérimental ces différences ont été rapportées.

Unités d'action faciale activées dans les sourires authentiques et faux

L'un des premiers chercheurs à s'intéresser aux différences entre les sourires authentiques et faux est Duchenne de Boulogne (1862), l'inventeur de l'électro-physiologie. Il a alors observé que les participants avaient tendance à activer presque toujours le *zygomatic major* et l'*orbicularis oculi, pars orbitalis* lorsqu'ils exprimaient ouvertement la joie qu'ils ressentaient et à activer uniquement le *zygomatic major* lorsqu'ils souriaient volontairement, sans ressentir aucune joie. Le *zygomatic major* a pour effet de tirer le coin des lèvres diagonalement vers les os des joues (voir la Figure 1). De son côté, l'*orbicularis* oculi remonte les joues, diminue l'ouverture des yeux et produit des pattes d'oies dans les coins extérieurs des yeux. Duchenne a aussi observé que les participants pouvaient facilement contracter le *zygomatic major* quand ils en recevaient la consigne, mais presque jamais l'*orbicularis oculi, pars orbitalis*.

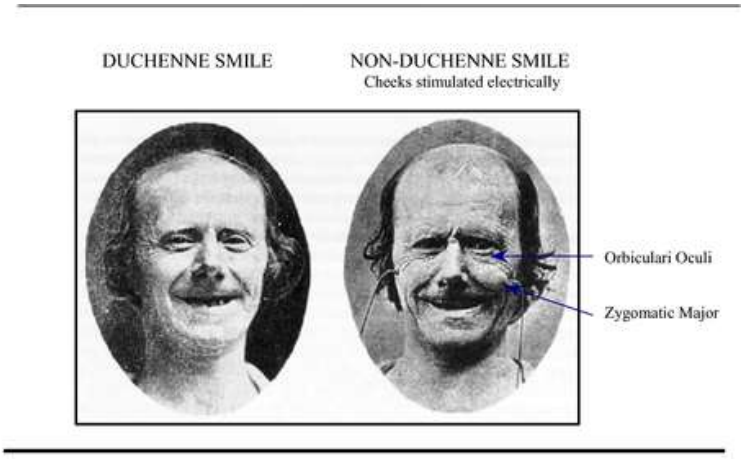


Figure 1. Unités d'action présentes dans le sourire de Duchenne (Fridlund, 1994).

À l'époque où vivait Duchenne de Boulogne, il n'existait aucun système de codification des mouvements faciaux. Ce n'est que dans la deuxième moitié du 20e siècle que de tels systèmes ont été développés, soit au moment où les travaux de recherche sur l'expression faciale des émotions ont connu un regain d'intérêt marqué. L'un de ces systèmes a permis des avancées particulièrement intéressantes en ce qui concerne les différences entre les sourires authentiques et faux. Il s'agit du Facial Action Coding System, développé par Ekman et ses collaborateurs (*FACS*, Ekman & Friesen, 1978; Ekman, Friesen & Hager, 2002). Ce système distingue 44 mouvements faciaux différents (appelés unités d'action) et permet de décrire l'activité du visage sous la forme d'une série d'unités d'action.

L'une des méthodes utilisées par les chercheurs pour identifier les différences entre les sourires authentiques et faux a consisté à présenter de courts films créés pour induire une émotion chez les participants, à filmer leur visage et à codifier les expressions produites à l'aide du FACS. Dans certaines études (Ekman & Friesen, 1974; Ekman, Friesen & O'Sullivan, 1988), les participants étaient interviewés après avoir vu les films plaisants et ils devaient d'abord décrire honnêtement ce qu'ils avaient vu, et ensuite dans le cas des films déplaisants, ils devaient

faire croire à l'intervieweur qu'ils avaient vu des films plaisants. Dans d'autres études, les participants ont simplement été filmés à leur insu pendant la présentation de films plaisants et déplaisants (Ekman, Friesen & Ancoli, 1980; Ekman, Davidson & Friesen, 1990). Enfin, de la même manière, Krumhuber et Manstead (2009) ont présenté des films plaisants à des participants et ont filmé leur visage à leur insu. Ensuite, ils ont demandé à ces mêmes participants de sourires volontairement. La majorité de ces études ont trouvé que les sourires authentiques comportaient plus souvent l'activation des unités d'action *Cheek Raiser* et *Lip Corner Puller* que les faux sourires. Seule l'étude de Krumhuber et Manstead n'a pas relevé cette différence. Toutefois, il se pourrait que cette absence de différence résulte d'un artefact de la méthode utilisée pour produire les faux sourires. En effet, selon les auteurs du FACS (Ekman, Friesen & Hager, 2002), il devient difficile pour les codeurs FACS de décider si l'unité *Cheek Raiser* est activée ou non lorsque l'unité *Lip Corner Puller* est de trop forte intensité. Or, les faux sourires produits dans l'étude de Krumhuber et Manstead (2009) étaient plus intenses que les sourires authentiques, ce qui peut survenir en contexte réel lorsque les individus tentent d'exagérer l'expression émotionnelle. Il faut aussi garder à l'esprit que près de 20% de la population peut contracter volontairement le muscle *orbicularis oculi* (Gosselin et al., 2002), ce qui peut expliquer non seulement la présence du marqueur de Duchenne dans les faux sourires, mais aussi, en partie, son absence dans le sourire authentique de faible intensité (Gunnery et al., 2013). Un autre groupe de chercheurs (Weiss, Blum, & Gleberman, 1987) a comparé des sourires faux et authentiques afin d'en identifier les différences en ayant recours à l'hypnose; leur prémisse de base voulant que l'état hypnotique permet à l'individu d'exprimer un état émotionnel de manière plus authentique. Dans un premier temps, les participantes ont été entraînées à produire, sous hypnose, des sourires de cinq intensités différentes, et parallèlement, de produire des sourires à l'éveil de la manière la

plus naturelle possible, dans le but de convaincre un observateur de l'authenticité du sourire produit. Les auteurs ont utilisé la vidéo pour enregistrer les sourires, et ont utilisé le FACS pour codifier les sourires ainsi réalisés. Les résultats obtenus vont dans le même sens de ceux présentés précédemment; l'unité *Cheek Raiser* étant activée plus souvent dans les sourires authentiques (64% des fois) que dans les faux sourires (51% des fois).

Une autre étude (Gosselin et al., 1995) a examiné la proportion d'occurrence du sourire comportant les unités d'action *Cheek Raiser* et *Lip Corner Puller* lorsque des acteurs, à l'aide de la méthode Stanislavski, ont produits des sourires pour lesquels ils ont ressenti de la joie. Cette méthode amène l'acteur à utiliser l'introspection afin de ressentir réellement les émotions à exprimer, une méthode analogue à celle utilisée dans les tâches d'imagerie affective du domaine de recherche de la communication émotionnelle. Les unités d'actions associées au sourire authentique sont survenues plus fréquemment (93%) lorsque la joie était ressentie que lorsque la joie était simulée (84%).

Symétrie du sourire

Un autre de ces indices à avoir attiré l'attention des chercheurs pour distinguer entre les sourires faux et les sourires authentiques fut celui de la symétrie du visage (Ekman, Hager, & Friesen, 1981; Hager & Ekman, 1985; Schmidt, Bhattacharya, & Denlinger, 2009). À l'instar des études portant sur les unités d'action faciales activées dans les deux types de sourires qui nous importent, les chercheurs du domaine ont identifié les caractéristiques des sourires authentiques et faux en induisant une émotion chez leurs participants, tout en enregistrant sur vidéo leur visage pour ensuite codifier les expressions produites grâce à plusieurs méthodes. Cette induction émotionnelle pouvait être accomplie en leur présentant de courts extraits de films

plaisants (Paul Ekman et al., 1981; Lynn & Lynn, 1943) ou à l'aide d'une tâche d'imagerie affective (Borod & Caron, 1980; Brockmeier & Ulrich, 1993; Hager & Ekman, 1997; Sirota & Schwartz, 1982). D'autres chercheurs ont demandé à leurs participants de produire volontairement les unités d'action associées à la joie ou l'expression émotionnelle complète de joie (Borod, Kent, Koff, Martin, & Alpert, 1988; Hager & Ekman, 1985; Okamoto, Haraguchi, & Takada, 2010; Schmidt et al., 2009; Schmidt, Liu, & Cohn, 2006).

En ce qui a trait à la codification, plusieurs techniques ont été utilisées pour analyser la présence de mouvements asymétriques dans le visage. Certains auteurs ont utilisé le FACS (Ekman et al., 2002) pour codifier les sourires (Ekman et al., 1981; Hager & Ekman, 1985). Ce dernier distingue cinq degrés d'intensité pour chacune des unités d'action, et lorsque la production d'une unité d'action est plus intense d'un côté du visage, il en résulte une expression émotionnelle asymétrique. D'autres chercheurs ont mesuré à l'œil ou à la main les différences de mouvements du visage produits (Borod & Caron, 1980; Borod et al., 1988; Brockmeier & Ulrich, 1993; Lynn & Lynn, 1943, Okamoto et al., 2010). D'autres ont eu recours à l'électromyographie pour mesure l'asymétrie faciale (Sirota & Schwartz, 1982) alors que certaines des études plus récentes ont utilisé un système automatisé d'analyse faciale par ordinateur (Schmidt et al., 2009, 2006).

La majorité des études recensées confirment les hypothèses d'Ekman (1980) et de Lynn & Lynn (1943) qui stipulent qu'un sourire authentique est généralement produit de manière symétrique et qu'un sourire faux comporte des mouvements musculaires asymétriques. En fait, une seule étude parmi celles recensées n'a pas révélé de différences entre les sourires authentiques et faux en ce qui concerne la présence de mouvements asymétriques du visage (Schmidt et al., 2009). Les principales distinctions remarquées entre les sourires faux et les

sourires authentiques relèvent du fait que la production d'un sourire faux est généralement plus intense d'un côté ou de l'autre du visage alors que les unités d'action impliquées dans le sourire authentique sont activées de manière aussi intense des deux côtés du visage.

Différences temporelles entre les sourires authentique et faux

Le troisième indice à avoir suscité l'intérêt des chercheurs concerne les caractéristiques temporelles qui distinguent le sourire authentique du faux sourire (Bugental, 1986; Cohn & Schmidt, 2004; Frank, Ekman, & Friesen, 1993; Hess, Kappas, McHugo, Kleck, & Lanzetta, 1989; Hess & Kleck, 1990; Schmidt, Ambadar, Cohn, & Reed, 2006; Schmidt, Bhattacharya, & Denlinger, 2009; Weiss, Blum, & Gleberman, 1987). Ces caractéristiques temporelles réfèrent à la durée totale du sourire, la durée de chacune des phases (ascendante, culminante et descendante) et la régularité de la vitesse de contraction ou de relâchement musculaire. La phase ascendante réfère à la portion du sourire qui se situe entre l'expression au neutre et l'expression du sourire à son apex. La phase culminante consiste au moment où le sourire est à son point le plus fort en intensité, et la phase descendante consiste à la portion située entre la phase culminante, et le retour de l'expression au neutre. La durée se distingue aussi des autres indices énumérés précédemment par le fait qu'elle ne se définit pas par sa présence ou son absence, comme la présence ou absence d'unités d'action par exemple, et qu'elle ne fait que varier dans sa quantité. Lorsque l'on parle de régularité du sourire produit, il s'agit de la vitesse de contraction et du nombre de phases produites par l'expression faciale. Une expression faciale régulière aurait tendance à être produite sans interruptions, ayant une vitesse et un mouvement constant (Brooks, 1986).

Encore une fois, les études qui se sont intéressées à cet indice ont examiné les différences temporelles entre des sourires correspondants aux critères du sourire authentique et du faux sourire. Ces sourires ont été obtenus en induisant l'émotion de joie chez des participants et en enregistrant l'expression faciale ainsi produite, la plupart du temps à leur insu. Cette émotion de joie peut être induite de plusieurs façons. Afin d'obtenir des sourires authentiques, la majorité des chercheurs ont présenté un court vidéo de nature plaisante à leurs participants (Cohn & Schmidt, 2004; Ekman & Friesen, 1974; Ekman, Friesen, & Ancoli, 1980; Frank et al., 1993; Hess & Kleck, 1990; Schmidt, Cohn, & Tian, 2003; Tarantili, Halazonetis, & Spyropoulos, 2005) et d'autres ont fait revivre une expérience émotionnelle vécue antérieurement à leurs participants (Hess et al., 1989; Hess & Kleck, 1990). Une autre méthode utilisée consiste à enregistrer les sourires produits par les participants pendant une entrevue, alors que ceux-ci ne s'y attendent pas (Schmidt, Ambadar, et al., 2006; Schmidt et al., 2009; Schmidt, Cohn, & Tian, 2003b). Afin de produire des sourires faux, les études recensées ont fait appel à la production volontaire du sourire (Hess et al., 1989; Hess & Kleck, 1990; Schmidt, Ambadar, et al., 2006; Schmidt et al., 2009). Bugental (1986) a obtenu des sourires authentiques et faux produits par des femmes en réaction à des enfants au comportement plus ou moins aversif. Weiss, Blum et Gleberman (1987), pour leur part, ont utilisé l'hypnose tel que décrit précédemment.

La durée est un critère fiable et relativement facile à mesurer en contexte expérimental : il suffit de visionner les stimuli sur vidéo, de cibler le sourire pertinent, et de mesurer la durée de ce dernier, en secondes ou en millisecondes. C'est d'ailleurs ce qu'ont fait la très grande majorité des différents groupes de chercheurs. Toutefois, les paramètres de ce qui constitue un sourire authentique ou un sourire faux (voir section *Unités d'action faciale activées dans les sourires authentiques et faux* ci-haut) varie d'une étude à l'autre. Il importe donc de demeurer prudent

lorsque vient le temps de synthétiser et de généraliser les résultats. Presque toutes ces études ont utilisé le FACS (Ekman et al., 2002) pour délimiter le début et la fin de chaque phases et du sourire complet. L'utilisation du FACS permet une codification fiable des caractéristiques temporelles du sourire, et nous permet de faire une comparaison valide avec les résultats d'études précédentes.

Durée totale

Les premières hypothèses formulées par Ekman et al. (1980; 1982) à propos de la durée totale du sourire authentique ont stipulé que ce type de sourire dure en moyenne près de 4 secondes et plus précisément, que sa durée n'est que rarement sous 330 ms, ni au-dessus de 4000 ms. Il a aussi été proposé qu'à l'intérieur du sourire authentique, la durée du sourire est corrélée avec le degré de joie (Ekman et al., 1980; 1982), ce qui sous-entend qu'un sourire authentique moins intense aurait tendance à être plus court, mais à l'intérieur des critères décrits ci-haut, alors qu'un sourire authentique très intense figurerait près de la borne supérieure de la durée du sourire authentique. L'ensemble des résultats obtenus appuient ces hypothèses. Parmi les études recensées, la durée moyenne du sourire authentique varie entre 660 et 4750 ms (Ekman, Friesen, et al., 1980; Frank et al., 1993). En contexte social, les sourires authentiques obtenus par Frank et ses collègues durent en moyenne 3320 ms alors que ceux obtenus en contexte solitaire durent en moyenne 4470 ms. Par contre, lorsque les cas extrêmes sont enlevés de leurs analyses, la durée moyenne passe tout juste sous la barre des 4000 millisecondes. En ce qui concerne le sourire faux, les résultats d'études révèlent une durée moyenne de 7090 ms (Frank et al, 1993). Les sourires authentiques se sont donc avérés soit plus longs que les sourires faux lorsque la durée totale varie entre près d'une seconde et de quatre secondes, soit plus courts que les sourires faux

lorsque la durée variait au-dessus de quatre secondes (Frank et al., 1993; Hess & Kleck, 1990). Dans les prochains paragraphes, nous décrivons les résultats des études réalisées sur la durée des différentes phases du sourire.

Durée des phases ascendante, culminante et descendante

L'ensemble des résultats obtenus montre que la durée moyenne de la phase ascendante du sourire authentique varie entre 490 et 930 ms (Bugental, 1986; Cohn & Schmidt, 2004; Schmidt et al., 2006, 2009, 2003a; Tarantili et al., 2005). Une seule étude a obtenu une moyenne supérieure à 1000 ms, soit 1396 ms (Weiss et al., 1987). La durée moyenne de la phase ascendante du sourire faux varie quant à elle de 540 à 770 ms (Bugental, 1986; Cohn & Schmidt, 2004; Schmidt et al., 2006, 2009; Weiss et al., 1987), ce qui suggère que la phase ascendante du sourire faux est en moyenne plus courte que celle du sourire authentique. Les résultats ne sont toutefois pas aussi concluants pour la phase descendante du sourire. Dans une étude, la phase descendante du sourire authentique (2390 ms) était de plus longues durée que celle du faux sourire (1630 ms) (Bugental, 1986), alors que dans une autre, l'opposé a été remarqué (560 et 640 ms respectivement) (Schmidt, Ambadar, et al., 2006). Il faut noter que l'étude de Bugental n'a pas le même degré de contrôle sur la production des sourires, car la production de ces derniers s'inscrit dans un contexte beaucoup plus complexe que l'ensemble des autres méthodes utilisées par d'autres chercheurs pour produire des sourires faux et authentiques. Bugental a utilisé les expressions d'encodeurs qui devaient sourires suite à un comportement obéissant ou désobéissant de la part de jeunes enfants. Enfin, la durée de la phase culminante des sourires a été très peu étudiée. Contrairement à l'hypothèse d'Ekman et Friesen (1982), voulant que la phase culminante du faux sourire soit de plus longue durée que celle du sourire authentique, les

résultats de Hess et Kleck (1990a) ne révèlent aucune différence significative entre ces deux types de sourires dans les trois phases du sourire. Globalement, les résultats recensés appuient l'hypothèse que les phases ascendantes et descendantes du faux sourire sont généralement plus courtes que celles du sourires authentique. D'autres études seront nécessaires pour vérifier les différences temporelles des phases culminante et descendante entre sourires faux et authentiques.

Régularité de la vitesse de contraction et de relâchement musculaire

Les quelques études qui ont été réalisées à ce sujet sont unanimes. La vitesse de contraction du sourire authentique est moins variable que lorsque le sourire produit est faux (Cohn & Schmidt, 2004; Frank et al., 1993; Hess et al., 1989). L'ensemble des données indique que cette différence est répandue sur au moins deux (phases ascendante et descendante) des trois phases du sourire. Les résultats de Frank et al. (1993) indiquent une différence pour les trois phases du sourire. Plus précisément, la vitesse de la phase ascendante du sourire authentique est plus régulière et comporte moins d'irrégularités (14.67% vs 32.33%) que celle du sourire faux (Hess & Kleck, 1990; Weiss et al., 1987). Les mêmes résultats ont été obtenus pour la phase descendante du sourire. Enfin, d'autres études ont révélé que la vitesse de contraction des phases ascendante et descendante du faux sourire est plus rapide que lorsque le sourire produit est authentique (Cohn & Schmidt, 2004; Schmidt, Ambadar, et al., 2006; Schmidt et al., 2009). Ces résultats vont dans le même sens que les hypothèses initialement proposées par Ekman et Friesen (1982). La prémisse de base derrière ces différences relèverait du fait qu'une émotion fausse exige un contrôle supplémentaire, étant plus exigeante cognitivement que lorsque qu'un message authentique est produit (Ekman & Friesen, 1972). Le traitement cognitif conscient de la production de l'expression serait donc la cause de ces irrégularités.

Jugement de l'authenticité du sourire

Les chercheurs qui se sont intéressés à la question du jugement de l'authenticité ont examiné si l'individu non entraîné est capable de distinguer une expression faciale émotionnelle authentique d'une expression faciale non authentique. En d'autres mots, est-ce que l'individu moyen est capable de décoder ces indices, et donc, de manière pragmatique, de faire la différence entre un vrai sourire et un sourire faux? L'ensemble de la littérature est plutôt partagé. Les études réalisées sur le sujet ont révélé que l'être humain n'est pas très habile lorsqu'il doit faire la distinction entre ces deux types de sourires (Feldman et al., 1979; O'Sullivan, Ekman, & Friesen, 1988). Les humains sont généralement meilleurs en vieillissant, une amélioration qui nous parait intuitivement comme le résultat de l'exposition et de l'expérience. D'autres études un peu plus récentes suggèrent que les individus performent de manière supérieure au niveau attribuable au hasard (Ekman et al., 1988; Hess & Kleck, 1994b; Kirouac & Gosselin, 1994, Chartrand & Gosselin, 2005).

Les adultes semblent capables d'utiliser différents indices pour bien juger si le sourire produit est authentique ou non, mais cette habileté est loin d'être parfaite. Des études démontrent que l'individu performe à un niveau supérieur au hasard pour identifier un sourire spontané mais qu'il n'y arrive pas toujours lorsque le sourire est fait de manière fausse (Hess & Kleck, 1994a). Frank et al. (1993) ont étudié la sensibilité à l'unité d'action *Cheek Raiser* et à la durée totale des sourires. Ils ont par la suite questionné les participants sur les indices utilisés. Ils ont conclu que les sourires avec le marqueur de Duchenne (*orbicularis oculi*) étaient perçus comme plus authentiques que ceux ne comportant pas ce marqueur. Généralement, ceux qui étaient en mesure d'utiliser cette unité d'action dans leur jugement d'authenticité avaient tendance à mieux performer sur la tâche de jugement. D'autres chercheurs ont demandé à leurs participants de

poser un jugement d'authenticité suite à la présentation d'extraits vidéo contrôlés pour les unités d'action et l'asymétrie présentes, et ont remarqué que les adultes utilisent le marqueur de Duchenne pour évaluer si la personne est très contente. Par contre, ils n'ont pas semblé être en mesure d'utiliser l'indice de symétrie du visage pour faire le même jugement. Les enfants de 6 et 7 ans n'ont pas réussi à utiliser ni l'un ni l'autre des indices (Gosselin, Perron, Legault, & Campanella, 2002). Chartrand et Gosselin (2005) ont étudié la détection des indices faciaux chez les adultes et leurs résultats indiquent que les participants ont été en mesure de détecter les différences entre les sourires authentiques et ceux produits volontairement. Ils ont été meilleurs à détecter les indices d'asymétrie que l'unité d'action *Cheek Raiser*. Il est d'ailleurs intéressant de noter que les auteurs croient que cette habileté est limitée par des facteurs perceptifs et qu'elle n'est pas facilement modifiable. Étonnamment, les participants ayant reçus de l'information au préalable sur les indices n'ont pas mieux performé à la tâche, ce qui semble appuyer leur hypothèse.

Dans l'ensemble, la littérature n'est toujours pas concluante en ce qui a trait à la capacité des individus à bien juger de l'authenticité des expressions faciales. Les résultats obtenus sur le jugement de l'authenticité et des indices utilisés dans son jugement ne sont pas univoques. Est-ce que les êtres humains sont tout simplement malhabiles à reconnaître les indices ou utilisent-ils d'autres indices non pertinents au bon jugement de l'authenticité de l'expression faciale émotionnelle de joie ? Il est possible que l'interaction entre maints indices rende l'analyse en temps réel assez complexe. Existe-t-il un indice plus facile à détecter, interpréter et mesurer ? Nous croyons que ce jugement peut être amélioré lorsque d'autres facteurs sont pris en considération. Parmi ces facteurs figurent les mesures dynamiques et temporelles (Krumhuber, Kappas, & Manstead, 2013).

En 2004, Sato et Yoshikawa ont examiné le rôle de la vitesse de la phase ascendante sur le degré perçu de naturel (naturalness) pour les six émotions de bases. Les stimuli utilisés proviennent du Pictures of Facial Affect (Ekman & Friesen, 1976) et ont été artificiellement modifiés de manière à contrôler la durée de chaque cadre (frame) présenté. Globalement, les sourires dont la phase ascendante est présentée plus longtemps (2040 ms) ont été perçus comme moins naturels alors que ceux présentés pour 255, 510, et 1020 ms ont été respectivement jugées plus naturels. Il faut toutefois garder en tête que le concept de naturel n'équivaut pas parfaitement à celui d'authenticité (une expression perçue comme naturelle peut ne pas être perçue comme authentique). Cependant, il s'agit de concepts qui vont souvent de pair. Ces résultats concordent avec les résultats d'études décrits précédemment, qui suggèrent l'existence d'une durée de la phase ascendante (environ 1000 ms) liée à un niveau de naturel ou d'authenticité perçu plus élevé du sourire.

Dans une étude qui se rapproche davantage de ce qui a été fait dans notre ouvrage, Krumhuber et Kappas (2005) ont évalué, dans une série de trois travaux, l'effet de la dynamique temporelle des différentes composantes dynamiques sur l'authenticité perçue du sourire. Les stimuli utilisés dans leurs études sont créés artificiellement à l'aide d'un logiciel d'animation (Poser) et les paramètres sont manipulés de manière à correspondre à cinq durées préétablies. Les stimuli sont présentés à l'écran et les participants (n = 35) doivent juger du degré d'authenticité sur une échelle Likert en 5 points. Les durées ont été choisies de manière à varier approximativement entre 100 et 500ms. Pour la phase ascendante, les paramètres sont de 133, 233, 333, 433, et 533 ms. Les paramètres de la phase descendante sont sensiblement les mêmes, à 167, 267, 367, 467, et 567 ms. Les stimuli présentés correspondent seulement à la phase étudiée suivie ou précédée de l'expression au neutre, donc dans le cas de la phase ascendante, le

visage au neutre et la phase ascendante sont présentés successivement. La première étude, qui vérifiait uniquement l'effet de la durée de la phase ascendante sur le jugement d'authenticité, a indiqué un effet significatif. En d'autres mots, plus la durée de cette phase était longue et plus les participants ont jugé cette portion du sourire comme authentique, et donc, plus elle se rapprochait de 500 ms, et plus il était considéré comme authentique. Les sourires dont la phase ascendante durait 567 ms ont été perçus significativement plus authentiques que ceux dont la phase durait 167 et 267 ms Le même effet a été observé pour la phase descendante alors que la sourire avec une phase descendante de 567 ms a été perçu comme plus authentique que celui de 167 ms. La deuxième étude a repris la même méthode mais en vérifiant seulement l'effet de la manipulation de la durée de la phase descendante, tout en ajoutant deux autres paramètres de plus longue durée (667 et 767 ms). Le même effet linéaire croissant a été remarqué. De plus, le jugement d'authenticité lorsque la durée de cette phase était la plus courte s'est avéré significativement différent du jugement d'authenticité pour le paramètre le plus long. Précisément, les sourires dont la phase descendante durait 167 et 267 ms ont été perçus comme moins authentiques que celui dont cette phase durait 767 ms. Aucune différence n'a été décelée entre les sourires dont les phases descendantes variaient entre 367 et 767 ms. Ceci suggère l'existence d'un intervalle de durée de la phase ascendante qui distingue le sourire authentique du sourire moins authentique ou faux. Il faut cependant noter que le paramètre le plus court était très court (133 et 167 ms). Dans leur troisième étude, la durée de la phase ascendante et de la phase culminante a été manipulée. Pour ce faire, six nouveaux paramètres de durée ont été sélectionnés (367, 967, 1967, 2967, 3967, et 4967 ms) alors que pour la phase ascendante, le paramètre le plus court (133 ms) et le paramètre le plus long (533 ms) des études précédentes ont été utilisés. Les résultats ont reproduit ceux obtenus pour l'étude 1, et ont aussi révélé un effet significatif de la durée de la

phase culminante. Corroborant les affirmations d'Ekman et Friesen (1982) qu'une phase culminante trop longue rendrait les sourires plus faux, les participants ont jugé une phase culminante plus courte comme plus authentique sur l'ensemble des paramètres. Ils ont aussi démontré qu'un sourire plus long que 4 secondes était perçu comme significativement plus faux qu'un sourire de 4 secondes ou moins. Dans leur totalité, ces trois études de Krumhuber et Kappas respectent les observations mise de l'avant en 1982.

D'autres travaux ont appuyé l'hypothèse inverse; qu'il soit possible que les êtres humains ne semblent pas utiliser la dynamique temporelle lorsqu'ils doivent juger l'intensité de la joie ressentie. Une des premières études à aller à l'encontre des résultats décrits ci-haut fut celle de Hess, Kappas, Kleck, McHugo et Lanzetta (1989). Les résultats de leur étude ont indiqué que les différences temporelles n'étaient pas prises en compte par leurs participants. Ces derniers devaient juger le degré de joie ressentie pour des sourires évoqués par un état émotionnel à valence positive et un sourire délibéré. Quoique la notion de joie n'est pas nécessairement la même que celle d'authenticité, leur contexte théorique, à l'image de ce qui se faisait dans le domaine à l'époque, tente de différencier les sourires faux des sourires ressentis, ce qui nous permet d'assumer qu'il s'agit ici de la notion d'authenticité du sourire.

Dans l'ensemble, la presque totalité de ces résultats pointent vers le fait que les observateurs semblent bel et bien sensibles à la dynamique temporelle. Elle semble particulièrement utile lorsqu'ils doivent juger de l'intention de l'individu produisant un sourire, et particulièrement de l'authenticité de son expression faciale émotionnelle. La durée des phases d'expressions faciales serait donc un indice fiable du degré d'authenticité du sourire.

Réflexion critique de la littérature

Tout en reconnaissant l'importante contribution des premières études dans le domaine, il faut noter que le concept de sourire authentique n'avait pas encore été clairement défini au départ tel qu'il l'est maintenant. La notion de sourire spontané se rapproche beaucoup de celle de sourire authentique, et il en va de même pour le sourire délibéré et le sourire faux. Il est toutefois possible que les différences trouvées étaient attribuables à d'autres facteurs, comme l'existence de normes sociales ou culturelles, plutôt qu'au reflet de l'état émotionnel sous-jacent à l'expression faciale. La même chose peut être dite pour les études qui ont vérifié le niveau de joie (happiness) (Hess et al., 1989). D'autres études, comme celle de Bugental (1986) n'ont pas contrôlé l'ensemble du visage (seul le bas du visage l'était) et donc leurs affirmations ne reflètent pas nécessairement leurs résultats dans le sens que nous l'entendons aujourd'hui. Heureusement, au fil du temps, les chercheurs se sont appliqués à préciser le concept de sourire authentique et le marqueur de Duchenne est devenu un marqueur du sourire authentique (quoique cette notion est remise en question, voir Krumhuber & Manstead, 2009) facile à appliquer et à observer en contexte expérimental. Il ne s'agit pas du seul indice distinguant le sourire authentique du sourire faux, mais il s'agit certainement d'un pas vers l'avant dans la spécification du concept de sourire authentique tel que nous l'appliquons dans la présente série d'études.

Une des limites majeures et inhérentes des études portant sur les différences entre une expression spontanée et une expression délibérée vient du fait qu'un sourire produit volontairement comporte presque toujours plus d'irrégularités, et en conséquence implique plus de phases. Ceci aura comme effet d'allonger la durée de l'expression, et cette variation n'est donc plus seulement attribuable à l'authenticité de l'expression faciale. Elle peut l'être en partie, et donc il y a un rapprochement à faire, mais ce lien peut être étudié plus directement en

redéfinissant les paramètres d'un sourire authentique ou faux. Cette limite handicape d'ailleurs grandement les conclusions de Hess et Kleck (1990). Il faut cependant tenir pour acquis qu'un sourire spontané réalisé dans un contexte social se doit d'être authentique.

Une autre limite de ce type d'étude est qu'il est très difficile pour un individu, même entraîné, de produire sur demande les différentes phases du sourire selon une durée définie. Ce n'est que récemment, avec l'avènement d'ordinateurs et de logiciels assez puissants, que nous pouvons étudier en détails les effets de la durée spécifique de chacune des composantes dynamiques des expressions faciales. Il existe deux façons de faire pour arriver à nos fins : soit utiliser des visages artificiels ou bien utiliser des extraits vidéos de visages humains réels, et de les manipuler artificiellement. Les visages artificiels, comme ceux créés à l'aide de logiciels d'animation, ont l'avantage d'être faciles à créer et à contrôler, mais amènent avec eux un problème de validité écologique. Puisqu'il est seulement question de contrôler un paramètre et de vérifier son effet, certains chercheurs affirme que l'utilisation de sourires artificiels reste acceptable. Cependant, la comparaison avec les résultats d'études antérieures (la plupart des études plus vieilles faites sur le sujet) utilisant de vrais sourires est questionnable, et la généralisation des résultats est pour le moins difficile à accepter. Nous ne connaissons d'ailleurs pas encore les fins détails de l'interprétation humaine de visages artificiels. Par exemple, Krumhuber et Kappas (2005) ont utilisé des visages synthétiques d'hommes pour réaliser leur étude de 2005 et ils ont décelé une différence significative entre les deux visages créés artificiellement. Il est bien difficile d'expliquer et même de comprendre cet effet puisque tous les paramètres (unités d'action utilisées, intensité, et durée) sont les mêmes. L'explication peut seulement se faire en l'arrimant à de vrais visages humains. Existe-t-il des visages dont la morphologie serait perçue comme naturellement plus authentique? Cette question amène avec

elle son lot d'interrogations. De l'autre côté, le désavantage d'utiliser de vraies expressions faciales émotionnelles est indubitablement d'ordre méthodologique. Il est d'abord très fastidieux de créer une banque de stimuli validés avec le FACS, qui à ce jour semble la méthode la plus rigoureuse et validée dans le domaine. Ensuite, la capacité de manipuler numériquement ces stimuli dynamiques afin de respecter des paramètres préétablis sans leur donner une impression fausse exige des habiletés particulières qui nécessitent une expertise certaine.

Aussi, plusieurs des études réalisées dans le domaine, par exemple celle de Krumhuber & Kappas, 2005, dans le but d'être le plus méthodique que possible, ont présenté des sourires décortiqués à leurs participants, c'est-à-dire dont les phases individuelles sont montrées et jugées de manière isolée. Ces auteurs suggèrent que la durée des différentes phases du sourire influence le jugement d'authenticité, mais encore une fois, il est difficile voire impossible de généraliser cette affirmation puisque cette situation ne survient presque jamais lors d'interactions sociales. Certaines études ont aussi présenté les expressions faciales en incluant le visage au neutre. Toujours dans l'étude de Krumhuber et Kappas, le visage est au neutre pendant une seconde, suivi ou précédé de la phase étudiée. Cette façon de vérifier son effet sur le jugement de l'authenticité peut créer un effet de plancher ou de plafond, particulièrement pour des visages réels, puisque les participants pourraient avoir tendance à juger ces sourires comme étant présentés sur demande, et donc plus faux. La construction de leur échelle aura donc d'importantes conséquences *(pas authentique --- très authentique vs peu authentique --- très authentique*). Nous croyons qu'il est préférable de présenter l'expression faciale avec le moins de neutre possible, afin qu'elle soit beaucoup plus représentative de ce que l'on retrouve en contextes sociaux réels.

Les études portant sur la dynamique temporelle et de son possible effet sur la perception qu'un observateur puisse avoir sur l'authenticité de l'expression faciale ne sont pas très nombreuses. Les études dans lesquelles la notion d'authenticité et sa variabilité attribuable à la dynamique temporelle ont été évaluées de manière systématique peuvent être comptées sur les doigts d'une main. Alors qu'au départ la durée du sourire en entier était mesurée, les chercheurs se sont progressivement attelés à mesurer les différentes composantes et phases dynamiques des expressions faciales émotionnelles. Nous parlons ici du début des années 1980, ce qui démontre qu'il s'agit d'un domaine de recherche encore peu exploré et pour lequel plusieurs questions subsistent encore. En conséquence, les paramètres utilisés dans les diverses études sont à ce jour encore choisis de manière informelle, probablement par manque de données empiriques. Certains chercheurs se sont penchés sur ce problème (Schmidt et al., 2003b) mais cela nécessite une labeur considérable et explique ce manque à combler.

Enfin, il faut garder en tête que les sourires authentiques ne le sont jamais parfaitement puisque dans un design expérimental, les paramètres doivent être méticuleusement contrôlés, et donc les stimuli (authentiques) produits sont très souvent faits volontairement, sans que l'individu ne ressentent nécessairement l'émotion qu'il tente d'exprimer à l'aide du visage, ou du moins, sans qu'il soit complètement représentatif d'un sourire réalisé de manière complètement authentique. Cette nuance ne devrait toutefois par affecter la généralisation de nos résultats. Aussi, les études présentées un peu plus haut semblent indiquer un corrélat entre la dynamique temporelle et la notion d'authenticité des expressions faciales émotionnelles, mais nous ne connaissons toujours pas de quelle manière cette information est perçue et interprétée par un observateur. Les études joignant cette question à l'utilisation de mesures neuropsychologiques, par exemple, commencent seulement à nous donnes des indices de réponses.

Objectifs généraux de la thèse et contribution originale à l'avancement des connaissances

La littérature actuelle nous offre maintenant un cadre beaucoup plus défini dans lequel travailler. Nous reconnaissons qu'un sourire authentique possède certains marqueurs, tel que la présence des unités d'action spécifiques à ce type de sourire, et qu'il existe un intervalle de durée pour lequel il est perçu comme plus authentique. Il a été décrit à plusieurs reprise que globalement, la durée d'un sourire authentique aura tendance à être plus longue que courte, et qu'elle ne doit pas dépasser 4 secondes, et qu'à un niveau plus microscopique, la durée des phases ascendantes, culminante et descendantes peut avoir un effet sur le jugement de l'authenticité, du moins dans les conditions spécifiques aux études présentées précédemment. Certaines études, très peu nombreuses, proposent même une phase ascendante qui oscille autour de 500 millisecondes (Cohn & Schmidt, 2004; Krumhuber & Kappas, 2005). Il est maintenant acquis que les marqueurs de durée sont perçus par l'individu, qu'ils sont utilisés dans le jugement de l'authenticité, et ce de façon relativement fiable.

La présente thèse a donc comme objectif d'éclaircir les connaissances que nous avons du lien entre la dynamique temporelle et le jugement de l'authenticité du sourire. Nous croyons avoir développé une méthode qui offre des stimuli plus adéquats pour étudier cette question de recherche. Cette méthode nous permet de créer des expressions faciales de sourires qui sont plus complètes et valides que ceux utilisées dans les études faites jusqu'à ce jour. À notre connaissance, il s'agit de la première étude à examiner ce lien en utilisant des expressions faciales émotionnelles de sourires humains réels, dont les composantes dynamiques ont été manipulées systématiquement, et validés avec le FACS. Les sourires sont présentés au complet, ce qui nous permet d'obtenir une validité écologique se rapprochant de celle d'un contexte social réel et ainsi une meilleure généralisation de nos résultats. Aucune autre étude n'a d'ailleurs

vérifié l'effet de la manipulation simultanée de la phase ascendante et descendante, alors que la phase culminante reste la même, sur le jugement d'authenticité du sourire. L'examen de ces deux phases du sourire, conjointement à l'examen de la phase ascendante et descendante du sourire devrait nous donner davantage d'informations sur son utilisation dans le jugement d'authenticité. L'examen systématique de la phase descendante, très peu étudiée auparavant, nous permettra aussi d'étoffer les affirmations d'Ekman et Friesen (1982).

Objectives of the Studies Presented in the Present Thesis

This thesis includes five studies aiming to examine the effects of temporal dynamics on the perceived authenticity of smiles, using videos made from photographs of human faces that are symmetrical in both duration and morphology, and which have been validated with the Facial Action Coding System.

Study 1 aimed to investigate the effect of various duration manipulations of the onset and offset phases of the smiles on their perceived authenticity. The duration parameters used in the first study were defined according to a consensus of results obtained from previous studies done in the field.

Study 2 was done to evaluate the perceptual abilities of participants, more specifically their ability to perceive temporal differences between two smiles using a two alternative forced choice task (2IFC task). This study used the same method as Study 3 in order to see whether asking participants to pay attention specifically to the duration of smiles would allow them to perform better in the task. In Study 3, in an attempt to further explore this relationship, participants were instructed to pay attention to the authenticity rather than the duration. The results of Study 2 and Study 3 combined give us a good idea of participants' abilities with regards to detecting temporal differences and making authenticity judgements. A 2IFC task was also used in studies 2 and 3 because it addresses a possible limitation of Study 1, which is that a free judgement task (as done in Study 1) is more likely to be harder for our participants due to the nature of the task. We believed that a 2IFC task, where the participant judges the difference between two stimuli rather than judging one smile at a time, would not tax the cognitive abilities of our participants as much as the method used in Study 1, and that this would therefore provide us with a clearer picture of their perceptual abilities.

Study 4 was aimed at validating the method used for the construction of our stimuli. In the first three studies, we constructed temporally symmetrical dynamic smile stimuli by time-reversing the onset of the smile to create the offset. But this creates a possible confound, since the onset might therefore be more natural than the artificially-created offset. Therefore, in Study 4 we created a new bank of stimuli, this time using the time-reversed offset of the original smile to artificially create the onset. We then replicated the procedure of Study 1 to see if the same patterns of responses would be obtained; meaning longer onset and offset of a smile would be perceived as more authentic.

Finally, study 5 was done to investigate the relationship between individuals' perceptual abilities and their judgements of authenticity. More specifically, we wished to determine if a better ability to detect temporal differences would lead to a stronger relationship between smile phase durations and authenticity judgments.

Chapter 2: Study 1: Effects of Temporal Dynamics on Perceived Authenticity of Smiles

Effects of Temporal Dynamics on Perceived Authenticity of Smiles

David Asselin

Patricia Brosseau-Liard, Pierre Gosselin, Charles A. Collin

University of Ottawa

136 Jean-Jacques Lussier

Vanier Hall

Ottawa, Ontario, Canada, K1N 6N5

This study has been published as:
Asselin, D., Brosseau-Liard, P., Gosselin, P., & Collin, C. A. (2020). Effects of temporal dynamics on perceived authenticity of smiles. *Attention, Perception, & Psychophysics, 82*(7), 3648-3657. https://doi.org/10.3758/s13414-020-02080-5

Abstract

We presented participants with videos of Duchenne smiles that differed in the duration of their onset, offset, or both, to determine if this would affect perceived expression authenticity. The duration of onset and offset varied between 0.2 and 1.0 s. Participants were shown one smile at a time and were asked to judge its genuineness on a rating scale. Results indicated the duration of offset had an effect on perceived genuineness when it was manipulated in isolation. Similarly, when both the offset and onset duration were adjusted concomitantly, genuineness ratings were affected. There was no effect of onset duration when it was manipulated in isolation. This is the first demonstration of these effects using photographs of real human faces that are dynamically and morphologically symmetrical, and which have been validated via the Facial Action Coding System.

Keywords: temporal dynamics, authenticity, genuineness, smiles, facial expressions, perception of emotions

Introduction

Emotions are not always transparently expressed through facial activity. Although many studies do support the claim that there is a concordance between the felt emotion and the expressed one (Gosselin et al., 1995; Rosenberg & Ekman, 1994; Ruch, 1995), facial activity can also be controlled voluntarily to display non-genuine emotional expressions. It has been suggested that there was a time in human evolution where there was a perfect concordance between emotions and facial expressions (Owren & Bachorowski, 2001), but that since then Hominidae have acquired the ability to produce facial expressions of emotions voluntarily. Among the numerous emotional expressions that can be voluntarily produced, the smile is arguably the most ubiquitous and has an important role to play in regards to social interactions among individuals (Bugental, 1986; Niedenthal et al., 2010).

According to Owren and Bachorowski (2001), smiling reinforces positive feelings towards other individuals, which increases the chances of receiving a favorable treatment in return. This positive feedback is recursive and, over time, reinforces attachment between individuals. It is thought that early humans eventually developed the ability to use false smiles in order to get resources from others. The ability to distinguish between false and genuine smiles then appeared and evolved over time. It is, however, only in the last 40 years or so that this distinction between genuine and non-genuine smiles has elicited serious interest from researchers.

In the context of this article, we will use the term “genuine smile” to designate the case where there is a concordance between what an individual feels and what they show through their facial activity. That is, a genuine smile occurs when an individual is happy. On the other hand, we will use the term “false smile” to describe when a person smiles in order to make others

believe they are happy even though they are not. The terms “authentic smile”, “genuine smile”, and “Duchenne smile” will be used interchangeably. These terms are similar to, but not identical with, the terms “emitted expression” vs “elicited expression” used by other researchers (McGettigan et al., 2015). Studies conducted since the early 80s have found many differences between genuine and false smiles, including differences in the action units that are activated during a facial expression, their symmetry, and their temporal dynamics (Ambadar et al., 2005; Ekman et al., 1980, 1988, 1990; Ekman & Friesen, 1974; Wehrle et al., 2000). The latter is of primary concern in the present article.

Studies of facial expressions of emotion have primarily used static images portraying the culmination of the emotional display as stimuli. While this has been useful as a means to detect differences in behaviour and performance elicited by the various emotional expressions, it is not particularly useful for the judgement of authenticity because this is not how emotional displays are reflected in daily life. That is, such maximum-intensity static images of facial expressions lack ecological validity. For that reason, in the current study we opted to examine the effects of temporal dynamics on the interpretation of judgments of genuineness of smiles. Below, we discuss previous findings regarding differences between authentic and false smiles, culminating in a review of the literature on differences in temporal dynamics. As will be shown, the results in this part of the literature are mixed, possibly because of differences in stimulus qualities. We aimed to address this by using videos stimuli of real human facial expressions of happiness that are validated through the Facial Action Coding System (FACS; Ekman & Friesen, 1982, Ekman et al., 2002), as well as being dynamically and temporally symmetrical. We reasoned that doing so would yield results that can be generalized to the interpretation of smile genuineness in everyday life.

Differences between authentic and false smiles

Action Units. Most studies that have tried to identify the differences between genuine and false smiles elicited an emotional reaction from participants using videos, interviews, or hypnosis and filmed their reactions in order to codify them with the Facial Action Coding System (Ekman et al., 1980, 1988, 1990; Ekman & Friesen, 1974; Krumhuber & Manstead, 2009; Weiss et al., 1987). The FACS is a tool that was developed to codify the different muscle groups in the face, called actions units (*AU*), and contains norms about the intensity, symmetry and temporal dynamics of their activations. With the exception of Krumhuber and Manstead (2009), all previous studies reported the activation of the Cheek Raiser and Lip Corner Puller action units during an authentic smile. Another study (Gosselin et al., 1995) examined the occurrence of the Cheek Raiser and the Lip Corner Puller action units when actors, using the Stanislavski method, produced smiles while feeling happiness. Significantly more action units associated with the authentic smile were activated when the happiness was felt (93%) compared to when it was simulated (84%). In order to distinguish false from authentic smiles, Ekman and Friesen (1982) suggested a few facial markers. The most well-known and well-studied is the Duchenne marker, which involves the activation of the Cheek Raiser AU. This has been considered a very reliable marker to distinguish authentic from false smiles, though there is still much debate regarding the use of this action unit as the barometer for authentic smiles. For instance, several researchers have observed that on average, between 17% and 30% of individuals can voluntarily control this muscle activation (Gosselin et al., 2002; Gunnery et al., 2013; Krumhuber et al., 2009; Schmidt & Cohn, 2001; Schmidt et al., 2006a). Even though a small proportion of people can voluntarily produce the Duchenne marker, a large majority of

authentic smiles are still composed of both the lip corner puller and the cheek raiser action units and these are therefore assumed to be valid markers of expression genuineness (Ekman, 1993).

Symmetry. The second cue that researchers have studied to distinguish authentic from false smiles is the symmetry of the facial expression. Symmetry here refers not to the static morphological differences between the left and the right side of an individual's face, but rather the difference in symmetry produced between the left and right sides during a dynamic facial expression of emotion (Borod et al., 1988; Borod & Caron, 1980; Brockmeier & Ulrich, 1993; Ekman et al., 1981; Hager & Ekman, 1985, 1997; Okamoto et al., 2010; Schmidt et al., 2006, 2009,2009; Sirota & Schwartz, 1982). The majority of these studies confirmed Ekman's (1980) hypothesis, which suggests that an authentic smile tends to be produced in a symmetrical fashion, while a false smile involves more asymmetrical action unit activations.

Temporal dynamics. Dynamic information is thought to be important in everyday decoding of emotional expressions and assessments of their authenticity. Several studies have addressed the role of dynamic information in the interpretation of facial expressions, but only a few have specifically addressed its effect on judgments of authenticity. Indeed, just a handful of studies (Bruce & Valentine, 1988; Kamachi et al., 2013; Wehrle et al., 2000) have demonstrated that dynamic characteristics provide useful information for the judgment of genuine smiles. One reason that such studies have been relatively rare is that creating well-controlled dynamic stimuli has, until recently, been quite difficult. Modern advances in technology have shown promise to diminish the problems associated with creating such stimuli, but it is still today a costly endeavor. One of the first studies examining the information provided by the dynamic properties of facial stimuli was conducted by Bassili (1978). His results showed that observers were better at identifying a face when a moving configuration of lights was used compared to a static

configuration. More recently, Lander and Bruce (2004) showed that the recognition of faces is better when their temporal dynamic remains unmodified, and that changing the rhythm of presentation reduced the recognition of faces.

Regarding facial expression, several studies have shown that dynamic properties differ between genuine and false smiles (Bruce & Valentine, 1988; Cohn & Schmidt, 2004; Frank et al., 1993; Hess et al., 1989; Hess & Kleck, 1990; Kamachi et al., 2001; Krumhuber & Kappas, 2005; Schmidt et al., 2006a, 2009; Wehrle et al., 2000). However, this alone does not show that humans are capable of detecting such differences or of using them to assess genuineness. To decode such differences, we first need to detect and interpret these cues. A few studies have demonstrated that the dynamic cues might not always be perceived or correctly interpreted by individuals (Hess et al., 1989; Hess & Kleck, 1994). For example, Hess and Kleck (1990) found that the duration of onset or offset did not have any effect on the accuracy of smile discrimination as their data showed no main effects or interactions for average onset and offset time. It is also possible that the wrong cues are used when attempting to distinguish between false and genuine smiles. Hess and Kleck (1994) found that that their participants were only somewhat better at identifying spontaneous expressions from posed expressions. While they were able to accurately identify spontaneous expressions of happiness and disgust at above-chance level, their performance significantly dropped for posed expressions of the same emotions, which they suggest to be the result of using invalid cues, like facial morphology or hairstyles (vs AU activation patterns, for example). However, in the results of this study the evaluated cues were collapsed across two emotions, happiness and disgust, making it impossible to know how much the results apply to smiles in particular.

Total duration. The duration of a smile, including all three of its different phases (onset, apex, offset), can simply be measured using recorded videos and quantified in seconds or milliseconds. The majority of researchers who have studied the temporal dynamics of smiles have used this approach (Bugental, 1986; Cohn & Schmidt, 2004; Frank et al., 1993; Hess et al., 1989; Hess & Kleck, 1990; Krumhuber & Kappas, 2005; Schmidt et al., 2006a, 2009; Weiss et al., 1987). Ekman (1980; 1982) first proposed that the mean duration of an authentic smile was around 4 seconds and that it rarely is shorter than 0.33 seconds. He added that the duration of the authentic smile is correlated with the degree of happiness. That is, a less authentic smile would tend to be shorter, while a more authentic smile would be longer, and nearer 4 seconds duration. Indeed, studies confirm this (Cohn & Schmidt, 2004; Ekman et al., 1980; Frank et al., 1993; Mavadati et al., 2016; Schmidt & Cohn, 2001); the mean duration of authentic smiles varies on average between 0.66 and 4.75 s. Conversely, past studies have shown evidence that false smiles last longer than authentic ones, with a mean duration of 7.09 s (Frank et al., 1993; Hess & Kleck, 1990).

Onset, Apex and Offset. While the smile can be taken as a whole, it is also possible to analyse it on a finer scale and discriminate three different phases within it. The onset duration refers to the length of time from the start of the smile until its maximum intensity, the apex duration is the length of time for which the intensity remains at its maximum, and the offset duration refers to the length of time from the end of the apex until the smile ends. Past literature suggests that the onset duration of a false smile is shorter than that of an authentic one. The mean duration for authentic smile onset varied up to 0.93 s (Bugental, 1986.; Cohn & Schmidt, 2004; Mavadati et al., 2016; Schmidt et al., 2003, 2006b, 2009; Tarantili et al., 2005) whereas the mean

onset duration of a false smile varied up to 0.77s (Bugental, 1986; Cohn & Schmidt, 2004; Schmidt et al., 2006b, 2009; Weiss et al., 1987).

With regards to the effects of the duration of the offset of smiles on their perceived authenticity, there does not seem to be a general consensus in the literature and we believe more work needs to address this with more valid and consistent stimuli. It was found by Bugental (1986) that the offset duration of authentic smiles (2.39 s) was longer than that of false smiles (1.63 s), but opposite results were found by Schmidt, Ambadar, et al., (2006), with findings of 0.56 s and 0.64 s durations for authentic and false smiles respectively. This discrepancy is most likely due to methodological differences. For instance, Bugental (1986) used a complex method for eliciting genuine and false smiles. Contrary to most recent research in this field, she did not control the social context in which the smiles were produced. Instead, she elicited interactions between elementary school-aged boys and adults by training some of the boys to be responsive to the adults, while other boys were chosen based on their unresponsive dispositions.

A similar study to ours (Krumhuber & Kappas, 2005) used Poser, a computer graphics program used to create artificial images of human faces, to examine the effect of onset, apex and offset duration on ratings of smile genuineness. Using the same duration parameters from two previous studies (Cohn & Schmidt, 2004; Schmidt & Cohn, 2001), they evaluated a segment of the smile specifically or a combination of segments, and found the temporal dynamic to influence the judgement of authenticity. More precisely, smiles with longer onsets and offsets were rated as more genuine, and the authenticity decreased as the duration augmented past a certain point. A limitation of this particular study was the use of computer-generated male-only models; Past literature shows evidence of gender stereotype effects in the judgement of facial expression, and particularly the smile (Hess et al., 2000, 2005). Also, while computer-generated

3D models of facial expressions are getting better at mimicking the real human face, they are still not as easily recognized as photographs of real human faces (Chamberland & Collin, 2020). Krumhuber and colleagues' (2012) results showed that artificial emotional facial expressions were rated by subjects to be about 70% comparable to their real human equivalent, and about 80% when it comes to the neutral facial expression (Amini & Lisetti, 2013; Krumhuber et al., 2012). This suggests that they would elicit poorer performance than photographs in terms of emotional expression categorization, although no previous study has examined this specifically.

Indeed, there is currently no evidence that computer-generated facial expressions are comparable to photographs of real human expressions in terms of recognition rates. Furthermore, as discussed in Roesch and colleagues (2011), even if individuals are able to accurately predict the emotional label associated to a computer-generated facial expression, and even if these are FACS validated, this is not enough to validate the use of such stimuli for more complex interpretation tasks like judgements of authenticity (Roesch et al., 2011). Finally, in a recent study, Chamberland and Collin (2020) compared photos from the Standard Expressor Version JACFEE (SEV-JACFEE) to FaceGen Modeller Core v3.18 (Singular Inversions, Toronto, ON) and found a significant difference in both accuracy of expression categorization and subjective ratings of emotion intensity between computer generated facial expressions and photos. This was the case for most expressions, including happiness. There results also suggested that there was confusion in terms of the information provided by the eye region of the face; This would be a serious impediment to the use of computer-generated facial expressions in studies on smile genuineness, because the eye region is thought to show the marker that distinguishes false from authentic smiles in real human facial expressions. Altogether, the previous results support the

affirmation that humans faces stimuli have a better ecological validity and should be preferred to using computer-generated ones.

Finally, as for the apex segment of the smile, it has barely been studied. The one study we are aware of which has examined this aspect of the smile duration (Hess and Kleck (1990) found no significant differences in apex duration between false and genuine smiles. This is contrary to Ekman and Friesen's (1982) hypothesis suggesting that the apex duration of an authentic smile should be shorter than the corresponding version of a false smile. In respect to the duration of the onset and offset segments of the smile, to our knowledge, no other studies have attempted to manipulate both simultaneously.

In summary, previous work shows mixed results regarding effects of the duration of different phases of smiles on their perceived authenticity. However, considering the literature as a whole, the results suggest that the onset duration and the offset duration of an authentic smile should both be generally longer than those of a false smile.

Objectives

The main objective of this study was to investigate whether the duration of a genuine smile has an effect on its perceived authenticity. More specifically, we wanted to determine if manipulating the durations of the individual temporal segments of a genuine smile (onset and offset) would influence judgements of its authenticity in different ways. The present study differs methodologically from previous studies (Krumhuber et al., 2007; Krumhuber & Kappas, 2005; Sato & Yoshikawa, 2004, 2009) in that we created stimuli of both genders that were photographic in nature and well-validated according to the FACS. Moreover, our stimuli were both spatially and temporally symmetrical, in that AU activations were equal across face halves

and smile onset and offset timings symmetrical. We decided to use all Duchenne smiles to control its possible effect as some studies have suggested that the Duchenne markers could be a marker of smile intensity rather than smile authenticity (Girard et al., 2019; Krumhuber & Manstead, 2009). Since symmetrical smiles are usually perceived as more authentic, we wanted to apply the symmetry to both the action units used and the duration of the phases of the smiles, which makes our stimuli completely symmetrical both spatially and temporally (the axis being the peak of the smile). While the spatial symmetry of smiles has been investigated quite extensively, no studies we are aware of examine their temporal symmetry. We also decided to create stimuli that were void of any neutral facial expression segments. That is, our stimuli start as soon as there is movement within the face, and ends immediately when the movement stops. It can be debated that a neutral facial display is only very rarely, if ever, seen in our daily lives and could potential interfere with the participants' interpretation of the emotional facial expressions, especially when included in an authenticity jugement task.

As the literature is fairly consistent concerning the onset (a longer onset is judged as more authentic), and because there is no clear consensus regarding the offset, we decided to use the same parameters for both phases of the smile, to see if we observe a similar effect. We chose to manipulate onset and offset durations to values of 0.2, 0.4, 0.6, 0.8, and 1.0 seconds, because this span encompasses the values found by the most recent literature for genuine and false smiles (Schmidt et al., 2006a, 2006b, 2009). Although findings in the literature regarding the durations of the various phases of genuine and false smiles are inconsistent, we predicted that longer onset and offset durations of our genuine smile stimuli would be associated with a higher perceived genuineness rating. This is based on the idea that genuine smiles with short onset/offset durations would provide a lower signal strength. They could therefore be judged as more ambiguous and

potentially less authentic. A second objective of this study was to investigate the perceptive abilities of individuals in regards to discriminating different durations of smiles and their temporal segments. That is, we also wanted to identify the minimum duration difference that leads to a difference in perceived smile authenticity.

For the purposes of this article, a genuine smile is defined as one that contains the following validated characteristics: 1) Action units 6 (Cheek Raiser – orbicularis oculi) and 12 (Lip Corner Puller – Zygomatic Major) are activated, 2) they are activated symmetrically, and 3) they are activated within the appropriate duration range.

Method

Participants

We performed an a priori power analysis using GPower (Faul, 2007) to estimate our sample size for a repeated measures anova (5 levels, power = 0.95, $\alpha = 0.05$). This indicated that 30 participants to be sufficient. The participants were 40 adults (27 females, 13 males) ranging from 17 to 27 years (M=19.5, SD = 1.61). All were recruited from the participant pool of a public university and received course credit for participating in the study. The participants were all French speaking.

Stimulus Materials

Three models were recruited in order to create the stimuli for this research. A Facial Action Coding system (FACS; Ekman & Friesen, 1982, Ekman et al., 2002) expert (the 3rd author of this manuscript, PG) that underwent extensive training and completed a FACS proficiency test, met individually with each model and gave him or her proper instructions for activating specific facial action units. Thus, the physical parameters of the smiles were controlled with the FACS. The FACS contains norms to code the intensity of action units and their

temporal dynamics. Five intensity levels, from A (very slight) to E (extreme), and three temporal phases (onset, apex and offset) are distinguished. Each smile was described in words by the FACS expert and illustrated with photographs. Then, the models were instructed to practice the target smiles while looking at their face in a mirror and receiving feedback from the FACS expert. After a few successful attempts, the models were videotaped while producing each of the three smiles 30 times, receiving feedback after each attempt.

The videos were subsequently coded by three coders who had previously passed the FACS proficiency test. The genuine smile involved the activation of Cheek Raiser and Lip Corner Puller. The former raises the cheeks, causing crow's-feet and bulges beneath the eyes, while the latter pulls lip corners up diagonally towards the cheekbones. The models were instructed to activate moderately (C level) and symmetrically these two action units for each side of the face, with onset and offset lasting about 1 s. A smile corresponding to those parameters is also known as the Duchenne smile (Ekman, 1993; Ekman & Friesen, 1982; Frank et al., 1993).

Selection and construction of the stimuli. From amongst the smiles that were approved by the FACS coders, three were selected to be used for the current study. One of the models was female and two were male. The smiles were then manipulated using a video editing program to alter the durations of the different temporal segments (onset, offset or both) to correspond to five distinct values: 0.2, 0.4, 0.6, 0.8 and 1.0 seconds. To maintain the realism of the original Duchenne smiles while changing presentation durations, the video clips were deconstructed into individual frames, and frames at regular intervals were removed before reconstructing the remaining ones into a video clip that matched the temporal requirements of each experimental condition. For instance, to create the .2 second onset version of a smile, every 5^{th} frame was kept from the original 1 second onset and all others were discarded. There were some minor

variations from this regularity that were imposed by the fact that the original onset and offset were not exactly 1 second in duration. The final stimuli all had the same duration. See Figure 1 for an example of the final frame of a stimulus onset.

Figure 1. 1. Example of a frame from stimulus videos. This is the final frame of the smile onset, also known as the apex of a smile, when its intensity is at its highest.

Procedure

After participants arrived at the laboratory, they were seated at a desk with a keyboard, mouse, and a 23" computer screen, placed 60 cm away from them. The experiment was automated using Superlab Pro 5 (Cedrus), a stimulus presentation application. The difference between a genuine and a fake smile was explained using two contextual situations. It was explained to participants that a person can feel happy and openly show it, in which case the smile would be authentic. In a different context, a person can smile yet not feel happy because he does not want others to know he is not happy. In this case, the smile would be fake. They were then

told they would see smiles and they would need to rate their authenticity on a scale. It was indicated that there were no right or wrong answers.

This experiment was divided into three parts (onset, offset and onset+offset). In the onset condition, only the onset duration was manipulated, and the participants were asked to pay attention to the moment between the start of the smile, its neutral state, and the moment when it was most intense. The onset duration was one of five values: 200, 400, 600, 800, or 1000 ms. The apex and the offset durations remained fixed at 1500 ms and 1000 ms, respectively. In the offset condition, only the offset duration was manipulated, again such that it lasted 200, 400, 600, 800, or 1000 ms. Participants were asked to pay attention to the moment between when the smile was most intense and the end of the smile, when it returned to a neutral state. The apex and the onset durations remained fixed at 1500 ms and 1000 ms, respectively. Finally, in the offset+onset condition, participants were asked to pay attention to the whole smile. Both onset and offset were simultaneously manipulated to both last 200, 400, 600, 800, or 1000 ms while the apex duration remained fixed at 1500 ms.

Following the presentation of each stimulus, participants were asked to rate the genuineness of the smile by clicking on the appropriate button on a five-point scale ranging from least to most authentic. The order of presentation for the three conditions was counterbalanced and the order of trials within each condition was randomized. Every model (3) x duration (5) was presented three times in each of the three conditions. Thus, the entire experiment consisted of 135 trials. The experimental sessions were done individually and the responses for each participant were recorded automatically.

Results

The mean rating of authenticity was calculated for each duration and each condition (onset, offset, both). Because all assumptions of analysis of variance were met, we proceeded with a one-way repeated measures ANOVA with 5 levels to examine the effect of the duration on the perceived genuineness of smiles. Below we discuss findings for onset, offset and onset+offset conditions in that order.

Onset duration

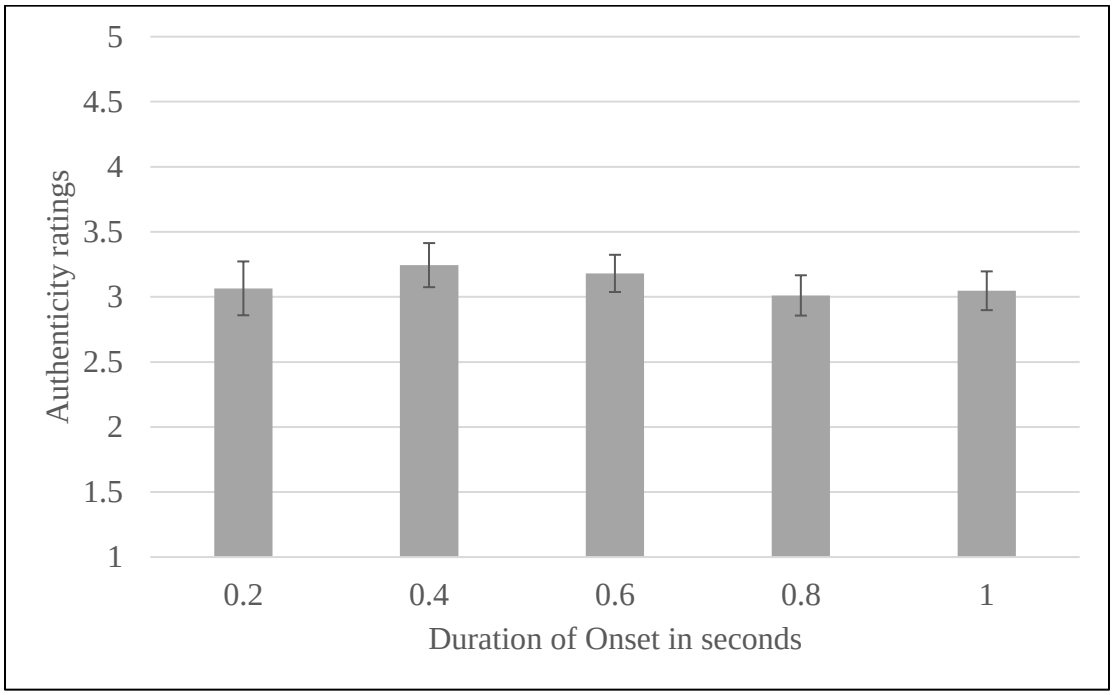


Figure 1. 2. The effect of Onset duration on authenticity ratings. Error bars represent standard errors of the mean.

In analyzing data from the onset condition, we found no evidence that smiles with shorter onset were perceived as less authentic than those with longer ones. This finding was unexpected, as one might predict that individuals would use the first moments of a smile to judge whether it is authentic or not. Instead, our data, as seen in Figure 1.2, showed no evidence that individuals are sensitive to a change in duration of the onset, $F(4, 156) = 2.241$, $p = .105$, even when it is one fifth of its normal span.

Offset duration

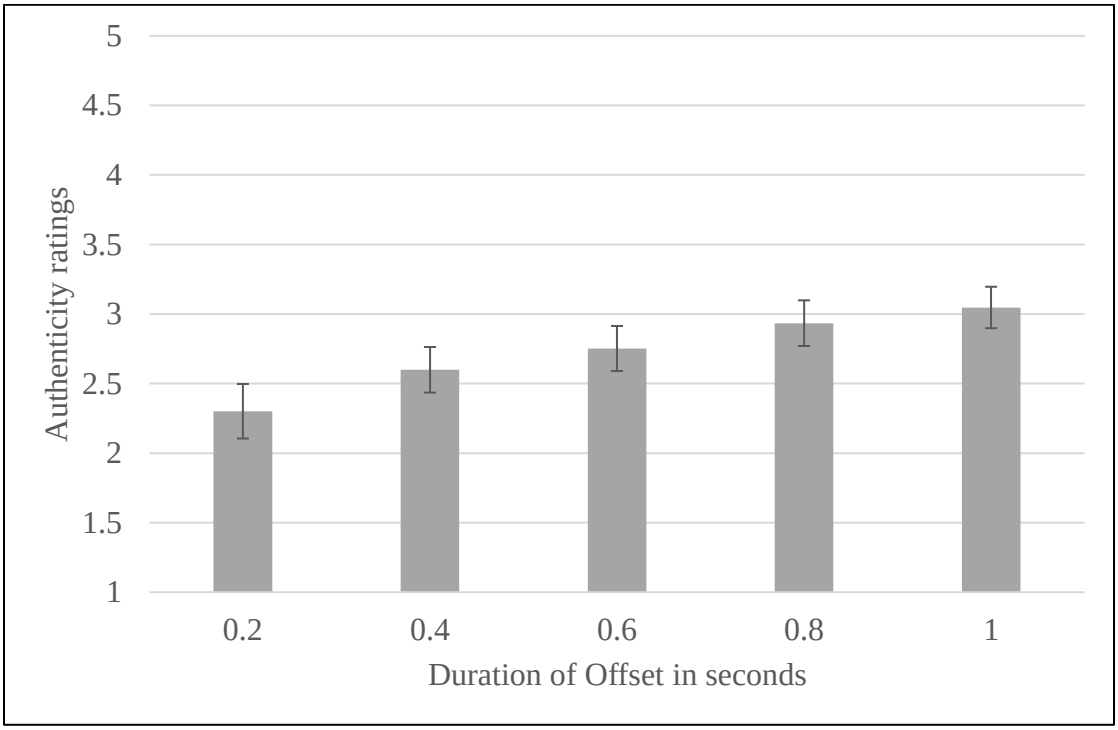


Figure 1. 3, The effect of Offset duration on authenticity ratings. Error bars represent standard errors of the mean.

In contrast to onset duration data, we found a clear and significant main effect of offset duration $F(4, 156) = 23.23$, $p < .001$. See Figure 1.3. In agreement with Ekman (2003), Tukey's multiple comparison tests indicated that smiles with offsets of 1 s were rated as more genuine than those with offsets of .2 ($p < 0.001$), .4 ($p < 0.001$), and .6 s ($p = 0.007$). The smiles with an offset of .2 s were judged as being less authentic than their longer versions. The mean rating of the latter was 2.30 while the average for the 1 s condition was 3.05.

The difference between the offsets had, in general, to be of .4 s or more to produce a statistically significant effect on participants' judgement ratings. Exceptionally, the participants were able to distinguish between offsets of .2 s. and .4 s. ($p < 0.002$). However, no other significant differences were found between smiles with offset contrast of less than .4 s.

Onset + offset duration

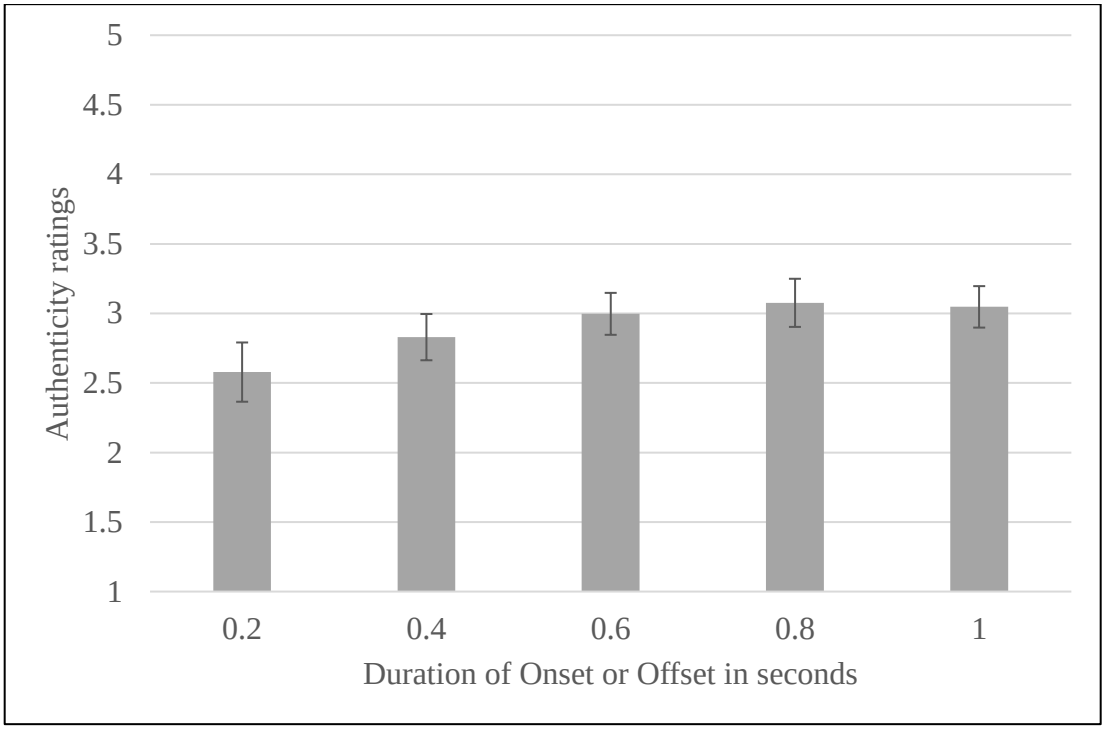


Figure 1. 4, The effect of Offset duration on authenticity ratings. Error bars represent standard errors of the mean.

As with the offset condition, the participants were found to be sensitive to the duration of the smile when the duration of both offset and onset varied, $F(4, 156) = 7.73$, $p < .001$, but not as much as in the condition where only the offsets varied. See Figure 1.4. Holm-Sidak's multiple comparison tests reveals that smiles with onsets and offsets of .6 ($p = 0.013$), .8 ($p = 0.014$) or 1 s ($p = 0.023$) were rated as more genuine than those with offsets of .2 s. No other significant differences were found.

Discussion

The goal of the present study was to investigate the effects of changes in temporal dynamics on the perceived authenticity of genuine human smiles. In doing so, we wanted to avoid using computer-generated facial expressions as they seem to be of questionable validity relative to photographs of faces (Chamberland & Collin, 2020; Roesch et al., 2011). We examined whether the duration of the onset and offset of a smile had an effect on judgments of authenticity. The results confirm that manipulations of temporal dynamics can have such an influence.

There was a clear and statistically significant effect of the offset duration as well as the onset + offset duration on the perceived genuineness of our smile stimuli. Surprisingly, manipulations of the onset duration alone had no significant effect on the judgement of authenticity. This is inconsistent with the past literature (Bugental, 1986; Schmidt et al., 2003a, 2006, 2009; Cohn & Schmidt, 2004; Tarantili et al., 2005; Krumhuber & Kappas, 2005), which

found that authentic smile onsets lasted longer on average than false smile onsets. However, it should be noted that most of the latter studies used artificial facial expressions and models, and that most of their stimuli showed only the isolated segments of the smiles (i.e., just the onset or just the offset) and not the whole smile.

While the previous literature does not show any general consensus regarding the effect of the duration of the offset on the perceived authenticity of smiles, we found a pattern whereby a longer offset duration was judged as significantly more authentic than a shorter one. This is in agreement with results obtained from Bugental (1986). Her results suggest that the offset of an authentic smile lasts longer than that of a false smile, though it should be noted that her measured durations were both well above our maximum duration of 1 s (2.39 s and 1.63 s respectively). Our results contradict those of Schmidt and colleagues (2006), which suggested that the offset of an authentic smile is shorter than that of a false smile. This is despite the fact that our tested range contained the values they found (0.56 s and 0.64 s for genuine and false smiles, respectively).

As for the onset + offset condition, this is the first time to our knowledge that such a manipulation has been examined. Our findings in this condition could be interpreted as a mixture of those found for onset and onset in isolation. That is, we find an effect of duration of onset + offset, but it is somewhat smaller than that found for offset alone. This suggests that manipulating the onset along with the offset in some way reduced the effect of the offset manipulation.

Why is it that the offset duration produced an effect on the judgement of authenticity of smiles but not the onset? Although the present study cannot answer this definitively, several possibilities present themselves. For instance, one plausible explanation is that this is simply a

recency effect. The offset might have more of an impact simply because, being the most recent information in memory, it is better recalled. This might be expected to have a particularly pronounced impact in facial emotion processing, where information is complex and ambiguous, and thus may test the limits of cognitive resources. Similarly, it could be that due to cognitive limitations and the large amount of information conveyed in real time by humans' facial activity, we have learned to use only what is most recently available to us (Deese & Kaufman, 1957; Murdock, 1962). We could also speculate that the beginning of a smile is more often mixed with other emotions due to its occurrence in various social contexts, whereas the end phase tends to contain fewer mixed facial expressions and might be seen as a more reliable marker. A third explanation involves the fact that individuals can control the AUs involved in authentic smiles to a certain extent (Gosselin et al., 2002; Gunnery et al., 2013; Krumhuber et al., 2009; Schmidt & Cohn, 2001; Schmidt et al., 2006a). It is possible therefore that humans put more emphasis on controlling the beginning of a facial expression, or are just good at doing it for a small amount of time, again, for reasons having to do with limits on cognitive resources. For those reasons, individuals may have learned to see the end of a facial expression as more relevant when it comes to judging its genuineness. In summary, it is possible that the offset is simply more informative about the genuineness of a smile, and that people have unconsciously learned to attend to it more when judging authenticity.

Our results are also in line with Ekman's (1980; 1982) proposition that the mean total duration of an authentic smile was around 4 seconds, and that the total duration of the authentic smile is correlated with the degree of happiness (Ekman, Friesen, et al., 1980; Frank et al., 1993). We could certainly refine their affirmations and propose that its ideal duration lies somewhere between 3.5 s and around 4 s as our control smile duration is 3.5 s and is consistently rated as

more genuine. Results also indicate that a minimum of 0.4 s duration difference between smiles was generally needed in order to induce a judgement difference. However, in the case of the offset condition, one exception occurred: The participants gave significantly different genuineness ratings to smiles with a 0.2 s versus a 0.4 s offset duration. This could once again mean that we are better at gathering important information from the offset than the other segments of the smile. It would be interesting to further validate this finding by testing adult's perceptual abilities, either with a discrimination task between two smiles of different duration, or by using a more precise scale. Another follow-up question of interest concerns whether participants would be as good at judging the authenticity of smiles, or at perceptually differentiating the durations of 2 facial expression stimuli when the models shown are in a real social context versus an experimental setting. We believe our video-editing methodology produced a level of ecological validity that was not reached in past literature. We addressed some of the issues raised by the literature, mainly regarding artificial models and facial expressions. However, as with any experimental study, the models shown to participants were recorded in a laboratory, and were not part of any social context. With recent technological advances, it would be a good idea to use real faces produced in an experimental setting, and implement it artificially in a social context in order to validate even further the necessity of having ecologically valid stimuli, and thus verify if this effect still applies.

Altogether, our results show not only the importance of dynamic properties of smiles but also the temporal aspect or durations of smiles in regards to the judgement of authenticity. These findings support the notion that the dynamic characteristics of a facial expression play an important role in expression interpretation by conveying crucial information about the meaning of an expression to an observer. As only a handful of studies (Bruce & Valentine, 1988; Kamachi

et al., 2013; Krumhuber & Kappas, 2005; Krumhuber et al., 2009; Wehrle, Kaiser, Schmidt, & Scherer, 2000) have demonstrated that the dynamic characteristics of the smile provide relevant information for the judgment of its authenticity, this topic of research will need further investigation in order to elucidate the effects of its different parameters.

Chapter 3: Study 2: Examining participants' perceptual abilities to detect duration differences in a 2IFC task

Introduction

There is a clear advantage of being able to detect whether individuals' facial expressions are genuine or not. We are often put into a situation where our social, financial or even physical well-being depends on our ability to correctly interpret the various non-verbal cues presented to us. Early in life, we learn that facial expressions are the most convenient way of expressing our emotional states. At the other end of this exchange, we learn that we can reduce the chances of being exploited by another when we know we can rely on and cooperate with someone (Frank, 2004). From an evolutionary perspective, it was proposed by Owren and Bachorowski that humans have not always been able to create a separation between the felt and the expressed emotion (2001). They proposed that during the early days of our species, what was felt was also directly expressed, but that over time, humans developed the ability to hide or dissimulate their emotions, which in turn led them to also develop the ability to distinguish false facial expressions from genuine ones. In the context of this study, we use "genuine smile" when there is a concordance between the felt emotion, and what the individual expresses through his facial expression. For example, a genuine smile follows closely or simultaneously a feeling of happiness. We will use "false smile" when there is a contradiction between what an individual feels and what he shows through his facial expressions. The illustration of this would be when a person smiles when in fact, he is not happy. Synonyms like authentic, real or spontaneous can be used interchangeably in lieu of genuine, while fake and posed can be used instead of false.

Previous studies demonstrated that smiles perceived as genuine indicated trust and signal higher earning opportunities (Centorrino et al, 2014). Johnston et al. (2010) also indicated how

perceivers spontaneously used the smile type where they needed to judge issues of trust and cooperation. These authors illustrate how individuals use facial expressions, and particularly their genuineness, to determine if they should trust someone. But what facial expressions cues are we using to determine if a smile is genuine or not? And are we good at doing so?

Recently, more and more software is being developed and tested to help us detect and analyze the various components of facial expressions in real time, which for cognitive limitations reasons aren't possible, or at the very least are very hard to do, for humans. For example, Restricted Boltzmann Machines (RMBs) and Extreme Machine Learning (Adegun & Vadapalli, 2020) are being used for distinguishing posed from spontaneous expressions (Wang et al, 2016). Electromyography (EMG) techniques (Perusquia et al, 2017) have also been used to distinguish spontaneous from posed smiles based on spatial and temporal dynamics of the face. Hassouneh et al. (2020) combined EEG and machine learning to do the same task, and showed promising results.

While EMG and machines learning techniques can be applied to very specific contexts, like laboratory research and airport security for example, it obviously cannot be applied in our everyday life, as we cannot have a machine connected to us at all time and do the work for us – even though that idea might not seem too farfetched in the near future. Machines have an obvious advantage over the human perceptive abilities because they can easily take in every millisecond of every pixel of an image while using sophisticated algorithms to find patterns and make sense out of it. But what about our own abilities? Studies have shown that humans are relatively good at identifying static images of smiles, and that facial expressions conveys important social information (Ambadar, 2006, Bruce & Valentine, 1988; Kamachi et al., 2013; Krumhuber & Kappas, 2005; Krumhuber et al., 2009; Wehrle, Kaiser, Schmidt, & Scherer,

2000) but once again, this specific ability as measured in the lab is potentially not ecologically valid when compared to the complexity of a real-time smile in a social context.

In a previous study, we were able to demonstrate an effect of the temporal dynamics on the perceived authenticity of smiles. However, even though our participants were able to judge smiles of different durations differently, they required a difference of about 0.4 seconds to be able to distinguish stimulus durations. This is unlikely to be the lower limit of human ability. Certainly, it does not approach the limit of the human visual system's temporal thresholds. In order to see if participants could discriminate across shorter duration differences, we implemented a sequential 2IFC discrimination task in the present study. The 2IFC task is a psychophysical procedure in which two stimuli are presented to a participant and they must choose one of them as the correct answer. Both alternatives are presented on every trial in random order. We believed this procedure would yield better accuracy at lower values of temporal duration difference because it allows direct comparison between two differing stimuli. It would also reduce a possible response bias.

Past studies were able to identify many differences between genuine and false smiles, like the action units that are activated during a facial expression, their symmetry, and their temporal dynamics (Ambadar et al., 2005; Ekman et al., 1980, 1988, 1990; Ekman & Friesen, 1974; Wehrle et al., 2000). We chose the smile because it is the one that is the most often encountered in everyday life, and it plays a very important role in our interactions with other individuals (Bugental, 1986; Niedenthal et al., 2010). It is also the facial expression that is the most often simulated (Ekman & Friesen, 1982; Ekman, Friesen, & O'Sullivan, 1988). The reader is referred to Chapter 1 for a more extensive description of previous findings regarding the main differences between authentic and false smiles.

Objectives of Study 2 and Study 3

The objective of Studies 2 and 3 was to examine the effect of the duration of a smile on its perceived authenticity while building on the strengths of Study 1, and addressing one of its limitations. In both Studies 2 and 3 we presented participants with pairs of dynamic Duchenne smiles that differed with respect to the duration of their onset, offset, or both simultaneously. While the duration of onset and offset was 1 s in the control condition, it varied between 200 and 800 ms in the experimental conditions. More specifically, in Study 2, in order to evaluate their perceptive abilities, participants were shown two smiles in a row (the control smile and one of the other types), and had to tell which one they perceived as the longest. In Study 3, participants were shown the same stimuli as in Study 2 but had to tell which one was the most authentic. The prediction behind these experiments, based on Ekman (2003), was that adults would perceive a smile with a shorter onset or offset as less authentic. We also hypothesized that a task involving a comparison between two stimuli would be easier for the participants, in contrast with a judgement task as seen in Asselin et al., (2020). We believe the former task does not elicit the working memory of the participants as much as the first experiment, as they do not have to compare a stimulus to their own representation of a genuine facial expression and because this is a sequential matching paradigm, there is very little memory capacity involved. We therefore believe these results will give us a better insight into the lower-level perceptual underpinnings of smile judgments.

Method

Participants

We performed an a priori power analysis using GPower (Faul, 2009) to estimate our sample size for a repeated measures ANOVA (effect size f = 0.25, 4 measurements, $r = 0.5$,

power = 0.95, α = 0.05). This indicated that 31 participants to be sufficient. The participants were 37 adults (21 females, 16 males) ranging from 17 to 50 years (*M*=20.89, *SD* = 5.56). All of them were recruited on a voluntary basis from a large public university located in Canada. The recruitment procedure was identical to that of Study 1.

Stimulus materials

The materials used for this study were the same as that of Study 1. See Figure 2.1 for an example of the final frame of a stimulus onset. Tables listing the various phase durations used in our stimuli can be found in Annexe G.

Figure 2. 1. Example of a frame from stimulus videos. This is the final frame of the smile onset, also known as the apex of a smile, when its intensity is at its highest.

Procedure

Participants were seated at a desk and explained the difference between a genuine and a false smile. However, unlike Study 1, the participants were told they would see different pairs of

smiles and would have to pick the one that they perceive as the most genuine by clicking on the appropriate button on the screen (FIRST or SECOND). This experiment was divided into three parts (onset, offset and onset+offset). As in Study 1, the participants were asked to pay attention only to a specific phase of the smile for the onset and the offset condition, and to pay attention to both phases in the case of the onset+offset condition. In the onset condition, the onset duration had one of five values: 200, 400, 600, 800, or 1000 ms, while the apex and the offset durations remained fixed at 1500 ms. In the offset condition, only the offset duration was manipulated, again such that it lasted 200, 400, 600, 800, or 1000 ms. Participants were asked to pay attention to the moment between when the smile was most intense and the end of the smile, when it returned to a neutral state. The apex and the onset durations remained fixed at 1500 and 1000 ms, respectively. Finally, in the offset+onset condition, participants were asked to pay attention to the whole smile. Both onset and offset were simultaneously manipulated to both last 200, 400, 600, 800, or 1000 ms while the apex duration remained fixed at 1500 ms.

Following the presentation of each pair of stimuli, participants were asked to pick the one that they perceive as the most genuine by clicking on the appropriate button on the screen (FIRST or SECOND). The order of presentation for the three conditions was counterbalanced and the order of trials within each condition was randomized. Every model (3) x duration (5) was presented three times in each of the three conditions. The experimental sessions were done individually and the responses for each participant were recorded simultaneously by Superlab Pro in a text document on the computer. The entire experiment consisted of 108 trials. See Annexe C for a complete description of the instructions given to the participants.

Results

Onset duration

In contrast with the results of Study 1, where participants were not sensitive to the onset duration in terms of how genuine they found it to be, there is evidence in this study that participants were able to detect onset duration changes F (3, 108) = 24.13, $p < .001$ ($R^2 = .401$). They were able to distinguish the longer from the shorter smile for all conditions. See Figure 2.2. When the onset duration was 200, 400, and 600 ms, they performed well over the chance level (M = 81.68%, M = 78.08%, M = 66.37%), t(36)= 10.38, $p < 0.001$, t(36)= 10.65, $p < 0.001$, and, t(36)= 5.35, $p < 0.001$ respectively. For the .8 s. condition, while not as good as the shorter offset conditions, the participants still performed above the chance level, (M = 56.46%), t(36)= 2.134, p = 0.034. These results suggest participants can perceive temporal differences as short as 0.2 s. even though the duration change occurs in the onset of smiles. This is an intriguing result, as participants were not sensitive to this parameter in Study 1 (Asselin, et al. 2020). In fact, they did not judge the authenticity of smiles differently when the onset duration varied in Study 1. Therefore, while individuals are clearly able to perceive these temporal differences, they nonetheless have little effect on the perceptions of authenticity.

Multiple comparisons tests comparing subjects' accuracy across all duration conditions revealed that all contrasts were significant, with the exception of 200 vs 400 ms onset duration conditions (whereas 400 vs 600 ms, $p < 0.001$ and 600 vs 800 ms, $p = 0.04$). This suggests that in general, a minimal difference of 200 ms is needed to detect an onset duration difference.

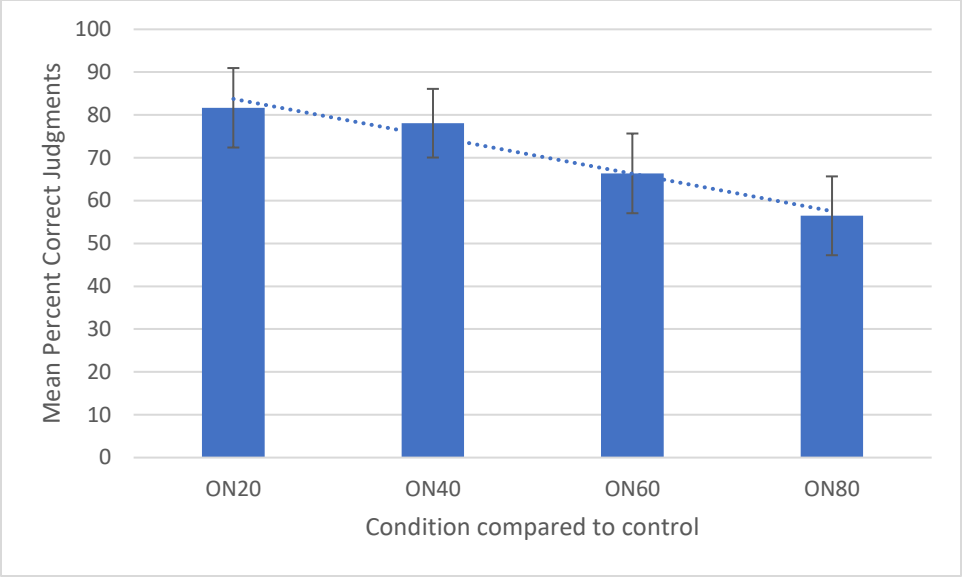


Figure 2. 2. Task performance at discriminating the longest smile duration for the Onset condition. Error bars represent standard errors of the mean.

Offset duration

As in the onset condition and as seen in Figure 2.3, participants were found to be sensitive to the duration of the offset of smiles F (3, 108) = 11.22, $p < .001$ ($R^2 = .238$). They all performed above the chance level for all four offset conditions. They were able to correctly identify the control condition (1 s.), $t(36) = 8.97$, $p < 0.001$, $t(36) = 7.66$, $p < 0.001$, $t(36) = 6.44$, $p < 0.001$ and $t(36) = 3.51$, $p = 0.001$ for the 200, 400, 600, and the 800 ms conditions respectively. Those results suggest participants can once again perceive temporal differences as small as 200 ms whereas a minimum of 400 ms was needed in Study 1 in order to detect an effect difference.

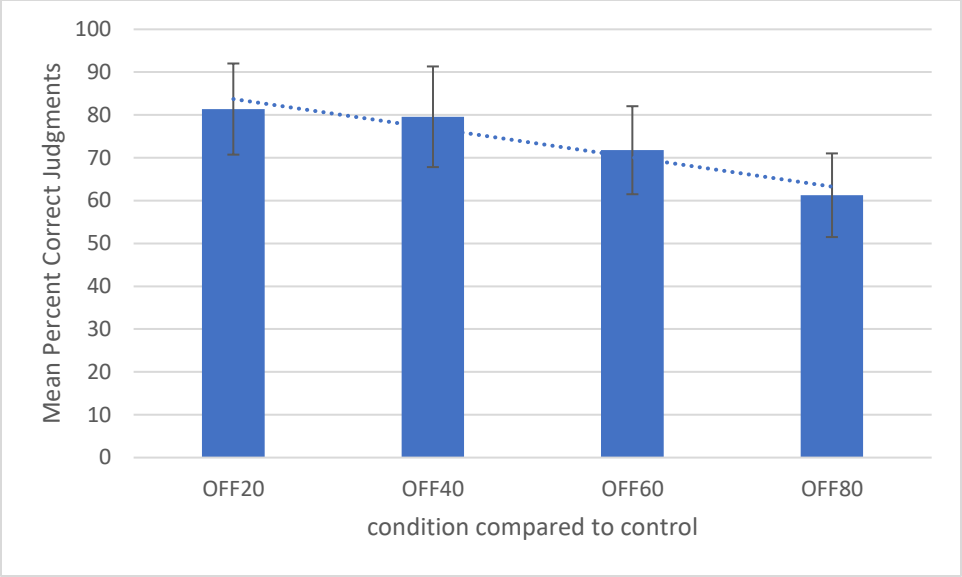


Figure 2. 3. Task performance at discriminating the longest smile duration for the Offset condition. Error bars represent standard errors of the mean.

Offset + onset duration

Like the onset duration condition, an effect of the onset + offset duration was found, F (3, 108) = 12.76, $p < .001$ ($R^2 = .262$). Participants were able to correctly identify the longer smiles among the different pairs. Their average performances were slightly better than in the onset only and offset only conditions, with means of 84.08, 79.58, 76.58 and 64.26%. All of these were significantly different from chance level, $t(36) = 10.62$, $p < 0.001$, $t(36) = 7.96$, $p < 0.001$, $t(36) = 9.55$, $p < 0.001$ and $t(36) = 5.51$, $p < 0.001$. Overall, these results indicate participants can again detect duration contrast of 200 ms and more. Results are illustrated in Figure 2.4 below.

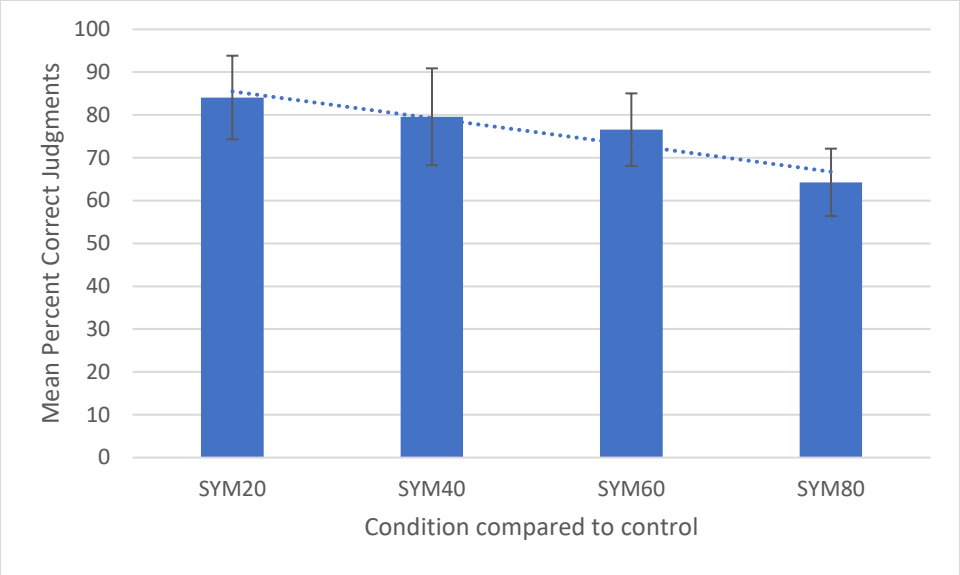


Figure 2. 4. Task performance at discriminating the longest smile duration for the Onset + Offset condition. Error bars represent standard errors of the mean.

Discussion

The goal of this experiment was to evaluate whether participants are sensitive to the change of duration in the various phases of a smile. As suggested by Chartrand and Gosselin (2005), it's possible that the judgement of authenticity is limited by perceptual abilities and that it cannot be easily modified. Although the results from Study 1 suggest that participants are indeed sensitive to this parameter for the offset alone and the onset + offset conditions, we cannot say, based on our results for the onset condition from Study 1, that participants are sensitive to the onset duration of smiles. We also do not know yet how good they are at perceptually detecting the duration changes in the 3 phases conditions (onset, offset, onset+offset). Our results demonstrate that participants are indeed sensitive to changes in

duration of smiles, and for all our conditions (onset, offset, and onset + offset). Whereas Study 1 showed that participants were not using the onset duration in judging the authenticity of smiles, Study 2 confirms that participants were able to correctly choose the longer smiles, and therefore are able to detect duration changes in the onset. Thus, it is not simply an inability to detect the duration changes that leads to these asymmetrical results. Comparing the results for each condition also tells us that participants are actually quite good at detecting duration differences. They were in general able to significantly perceive duration difference as small as 200 milliseconds, with the exception of the 200 ms onset and the 400 ms onset pairing. Altogether, our results point toward the fact that while individuals are clearly able to perceive these temporal differences in onsets of smiles, they nonetheless have little effect on the perceptions of authenticity. Our results also confirm that the 2IFC task seems to be a good choice of method to evaluate the abilities investigated in our experiments. Therefore, the comparison with results of Study 3 will give us further evidence on how they use their perceptual abilities in regards to the judgment of authenticity. The reader is referred to the results and discussion sections of Chapter 4 for a description of the comparison between the results and implications of Studies 2 and 3.

Chapter 4, Study 3, Examining the judgement of authenticity in a 2IFC task

Study 3 was similar to Study 2, but with the objective of measuring subjects' perceptions of smile authenticity rather than simple duration. See the introduction of Study 2 for more on the rationale of Study 3.

Method

Participants

We performed an a priori power analysis using GPower (Faul, 2009) to estimate our sample size for a repeated measures ANOVA (effect size f = 0.30, 4 measurements, $r = 0.5$, power = 0.95, $\alpha = 0.05$). This indicated that 26 participants to be sufficient. The participants were 40 adults (23 females, 17 males) ranging from 18 to 38 years of age (M=20.14, SD = 3.47). All of them were recruited on a voluntary basis from a large public university in Canada.

Stimulus materials

The materials used were identical to those of Studies 1 and 2. The order of the stimuli shown was randomized and the conditions counterbalanced across participants.

Procedure

As seen in Annexe D, the procedure was identical to that of Study 2 with the exception of the instructions given to the participants. They were told they would see different pairs of smiles and would have to pick the one that they perceived as most sincere by clicking on the appropriate button on the screen (FIRST or SECOND). The experiment involved three conditions (onset, offset and onset+offset). Within each condition, four comparisons (200 - 1000 ms, 400 - 1000 ms, 600 - 1000 ms, 800 - 1000 ms) were shown.

Results

Performance on the task was calculated for each duration comparison condition across each of the onset, offset and onset + offset conditions. Because all assumptions of analysis of variance were met, three one-way repeated measures ANOVAs with 4 levels were used to examine the effect of the duration on the task performance in each phase condition. Differences between the conditions were analyzed by means of Tukey's multiple comparisons test. We computed a multiplicity adjusted P value for each comparison. One-sample *t*-tests were used to determine the presence of a significant difference between the performance average and chance (50%). A participant's answer was rated as correct when they chose the control smile (1000 ms). Below we discuss findings for onset, offset and onset + offset conditions in that order.

Onset duration

As seen in Figure 3.2, in analyzing data from the onset condition, we found no evidence that the duration had an effect on the task performance, replicating results from Study 1. Results show no evidence that individuals are sensitive to a change in duration of the onset, $F(2.80, 109.1) = 0.22$, $p = .87$ ($R^2 = .005$). Consequently, participants did not perform better than chance at discriminating the control from the experimental stimulus. This result is expected, as it was previously demonstrated that the onset duration alone had no effect on the perceived authenticity of smiles (Asselin et al., 2020).

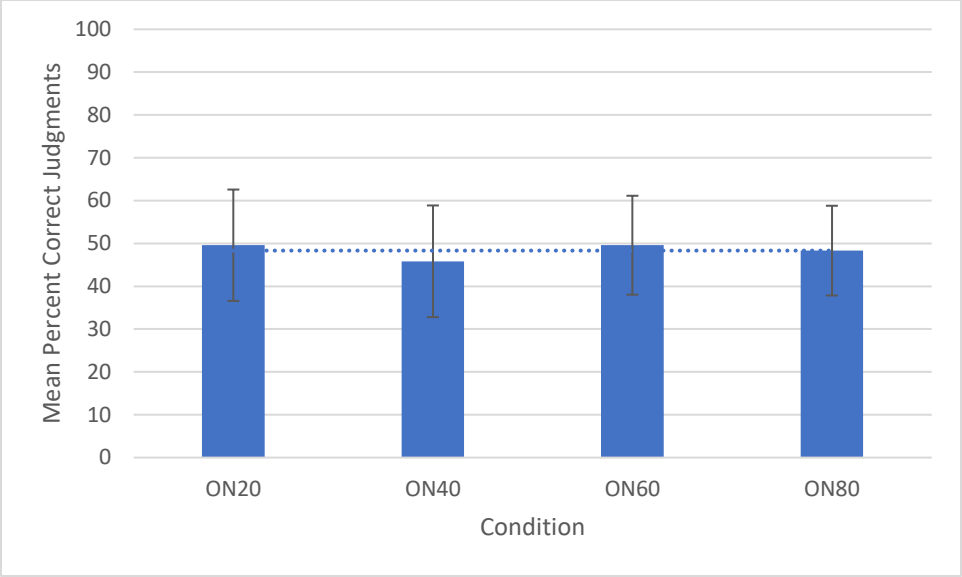


Figure 3. 1. Task performance at discriminating the control smile (most authentic) for the Onset condition. Error bars represent standard errors of the mean.

Offset duration

Results, as seen in Figure 3.3, and as opposed to the onset condition, indicated that participants were sensitive to the duration of the offset of smiles when choosing the most genuine smile, $F(3, 117) = 6.59$, $p < .001$ ($R^2 = .145$). The participants performed above chance level (50%) for all conditions. Smiles with offsets of 200 ms (t (39) = 6.42, $p < .001$), 400 ms (t (39) = 5.02, $p < .001$), 600 ms (t (39) = 2.30, $p = 0.03$), and 800 ms (t (39) = 2.11, $p = .04$), were perceived as less authentic than the control smiles (1000 ms). Furthermore, results indicated that the difference between the offsets had to be of 400 ms or more with the control condition to produce an effect on participants' judgement ratings. This again replicates the findings of Study 1.

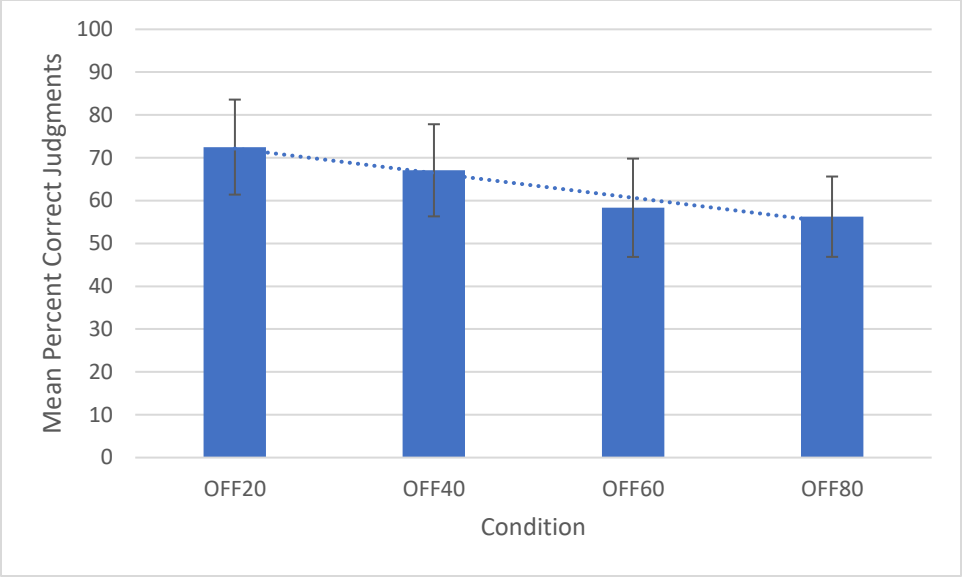


Figure 3. 2. Task performance at discriminating the control smile (most authentic) for the Offset condition. Error bars represent standard errors of the mean.

Offset + onset duration

As with the offset condition, there is an effect of the duration on the performance of the participants, F (3, 117) = 3.149, p = .03 (R^2 = .074). However, the participants seemed to be somewhat less sensitive to the duration of the onset and offset of smiles when compared to the offset condition. Only for smiles with very short onset and offset (200 ms), did the participants perform better than chance at choosing the most authentic smile, t(39)= 3.64, p = < 0.001. No other significant results were found. See Figure 3.4.

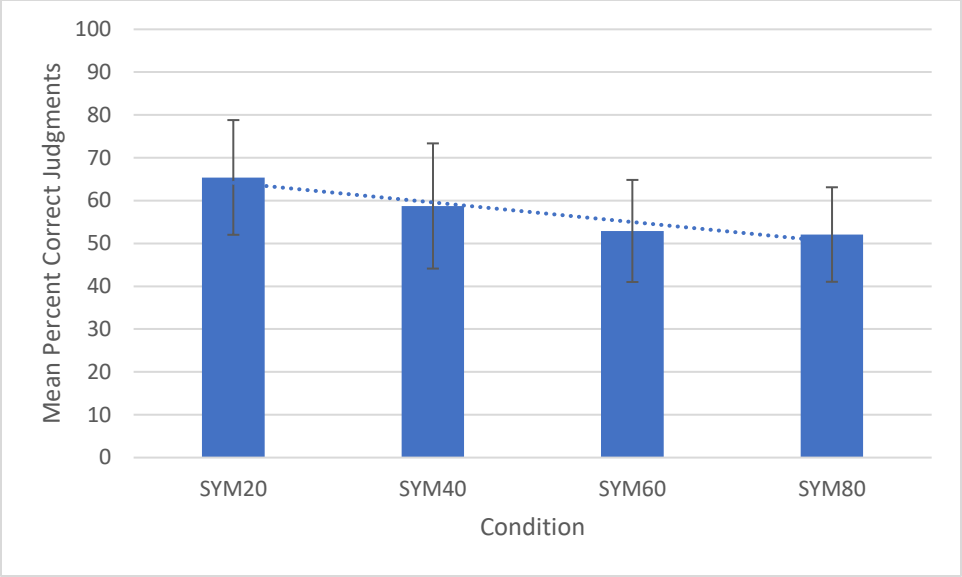


Figure 3. 3. Task performance at discriminating the control smile (most authentic) for the Offset + Onset condition. Error bars represent standard errors of the mean.

Discussion

The goal of this study, along with Study 2, was to validate the results of Study 1 and further explore the effects of temporal dynamics on the authenticity of smiles using a task we believed would be simpler for participants. Study 1 showed that participants are sensitive to the duration of smiles in judging their authenticity for the offset and the onset + offset conditions, which suggested that they did not seem to use the onset duration in judging the authenticity. However, Study 2 showed that they were sensitive to the duration of the smile, including the onset alone condition, as they were able to correctly choose the shorter smile over the 1000 ms smile. Taken altogether, results of Studies 1 and 2 confirm that individuals can perceive these temporal differences in both phases of the smile, while only using the offset or the onset + offset together to judge a smile's authenticity. In order to close the loop, we created Study 3 to show whether using the method used in the previous experiment would yield the same results as in Study 1 and confirm that participants are indeed not using the onset duration to judge the authenticity of a smile. Once again, we found that the onset duration had no effect on the task performance, while the effect of duration on the perceived authenticity for the offset condition, and the onset + offset condition remained. Replicating results of Study 1, each duration (200, 400, 600, 800 ms,) smiles for the offset condition were perceived as less authentic than the 1 s. smiles. As for the onset + offset condition, a similar pattern as in Study 1 was obtained, even though participants are less sensitive to the duration of this condition when compared to the offset condition. Overall, Study 3 reiterates that participants, even though they can detect temporal differences in the onset of smile, do not use it to judge the authenticity of smiles. The reader is referred to Chapter 2 for possible explanations for the occurrence of this phenomenon.

Chapter 5, Study 4: Verification of our stimulus construction method

Objective

This study was done as a means to determine if the way the stimuli were constructed in Studies 1-3 could have had an effect on their results. The stimuli in the previous studies were all constructed by taking the onset of a smile and temporally reversing it to create the offset. This was done to provide more control over the similarity in temporal parameters between onset and offset. However, it produces an obvious potential alternative explanation for our previous findings, in that the onset may be more "natural" than the offset and that this is the reason we found different results for effects of onset and offset duration. To investigate this possibility, we rebuilt our entire stimulus bank with the offset segment. That is, we created a set of dynamic smiles in which the onset was the temporally reversed offset. By doing so, we aimed to ensure that our previous conclusions are valid and not the result of a methodological artefact while further testing the replicability of our findings.

Method

Participants

The participants were 25 adults (24 females, 1 male) ranging from 17 to 32 years (M=19.96, SD = 3.03). All were recruited on a voluntary basis from the participant pool of a public university and received course credit for participating in the study.

Stimulus Materials

The stimuli for this study were identical to those in Studies 1-3, except that we used the temporally-reversed offset phase to create the onset phase here, whereas we had done the opposite in the previous studies.

Construction of the reference stimulus. A stimulus with symmetrical temporal dynamics wass used as a baseline for the creation of a new symmetrical stimulus with an onset phase equivalent to 1000 ms, peak phase to 1500 ms, and offset phase at 1000 ms. To achieve this, the release (or onset in the case of Studies 1-3) and culminating phases were individually isolated and deconstructed into images using Sony Vegas Movie Studio software. The start of the smile was cut out to remove the presence of neutral facial images. The sequence of the images was controlled by compressing or stretching over time, so that their duration was 1000 ms and 1500 ms respectively and the smile maintained its natural appearance. These image sequences were then reconstructed into video sequences. This initiation phase thus created was then reversed horizontally in time and juxtaposed at the end of the culminating phase. This 3500 ms stimulus became the symmetric control stimulus (SYM-100). These steps were reproduced for the other two models.

Modified Onset Phase. From the SYM-100 smile, the onset phase was isolated and time compressed so that it corresponded to 20%, 40%, 60% and 80% of the original duration of the onset phase of the SYM-100 smile. For example, 40% is 400 ms, 80% is 800 ms, and so on. This phase was juxtaposed with the culminating phase and the unaltered offset phase of the SYM-100 smile. Once compiled, these stimuli became ON-20, ON-40, ON-60 and ON-80 respectively.

Modified Offset phase. For the manufacture of stimuli whose release phase is modified (OFF-20, OFF-40, OFF-60 and OFF-80), only one horizontal inversion in time was necessary. For example, the ON-20 smile initiation phase became the OFF-20 smile release phase and so on for each of the stimuli. By doing so, the duration of the different phases of each smile is perfectly controlled and the same across all stimuli.

Modified Onset + Offset phases. From the SYM-100 smile, the onset phase was isolated and time compressed so that it corresponded to 20%, 40%, 60% and 80% of the original duration of the onset phase of the SYM-100 smile. The offset phase was created in the same way. These two phases were juxtaposed with an unaltered culminating phase of 1500 ms. These stimuli became SYM-20, SYM-40, SYM-60 and SYM-80.

Procedure

This study replicates the procedure of Study 1, with the exception of the computer monitor and the stimuli used. The monitor measured 24.5’’. Every model (3) x duration (5) was presented three times in each of the three conditions. Thus, the entire experiment consisted of 135 trials. The experimental sessions were done individually and the responses for each participant were recorded automatically. The complete instructions given to participants can be found in Annexe E.

Results

The mean rating of authenticity was calculated for each duration and each phase condition (onset, offset, both). Because all assumptions of analysis of variance were met, we proceeded with a one-way repeated measures ANOVA with 5 levels to examine the effect of the duration on the perceived genuineness of smiles and then compared them the results of Study 1 and the Control Study with unpaired t-tests. Results can be found below.

Onset duration

In analyzing data from the onset condition, we found no evidence that smiles with shorter onset were perceived as less authentic than those with longer ones. Our data, as seen in Figure

4.1, showed no evidence that individuals are sensitive to a change in duration of the onset, $F(3.387, 758.8) = 2.217$, $p = .077$ ($R^2 = .010$).

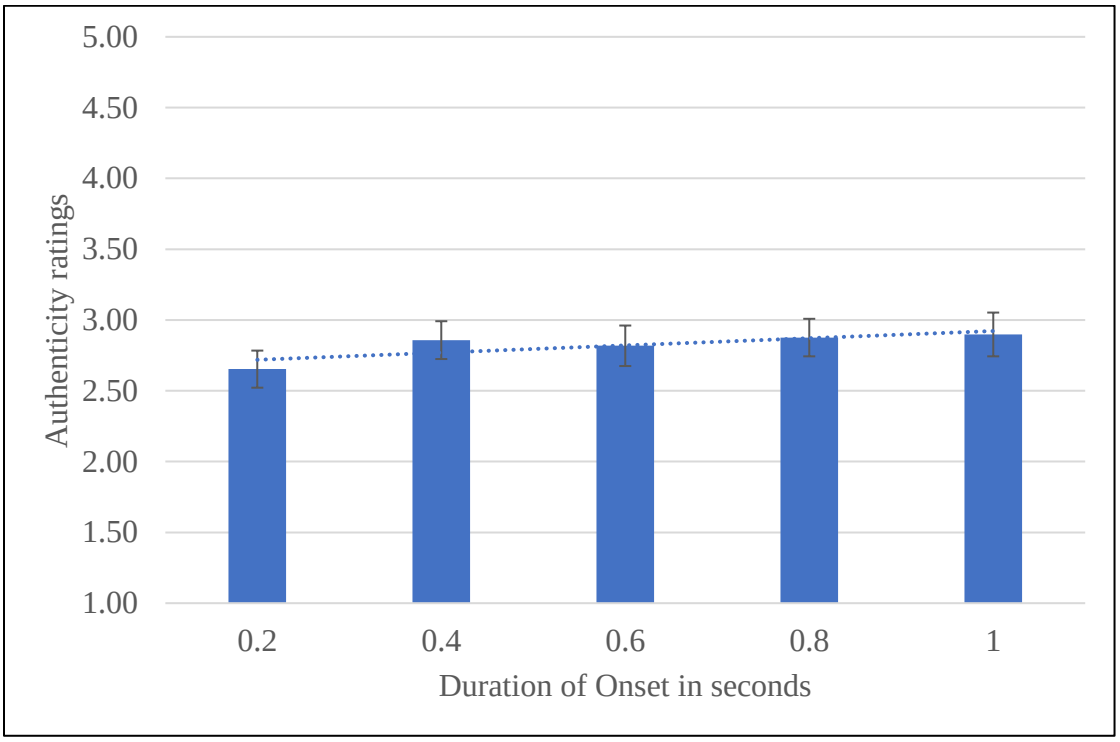


Figure 4. 1. The effect of Onset duration on authenticity ratings. Error bars represent standard errors of the mean.

Offset duration

In analyzing data from the offset condition, we found a clear and significant main effect of offset duration. As seen in Figure 4.2, individuals are sensitive to a change in duration of the offset, $F(4, 224) = 15.89$, $p < .001$ ($R^2 = .066$). Holm-Sidak's multiple comparison tests indicated that smiles with offsets of 1000 ms were rated as more genuine than those with offsets of 200 ms ($p < 0.001$), 400 ms ($p < 0.001$), but not 600 ms ($p = 0.331$). The difference between the offsets had, in general, to be of .6 s or more to produce an effect on participants' judgement ratings. An

unpaired t-test revealed no significant different between the results of Study 1 compared to those of the control study (200 ms condition, p = .95; 400 ms condition, p = .77; 600 ms condition, p = .94; 800 ms condition, p = .39; 100 ms condition, p = .37)

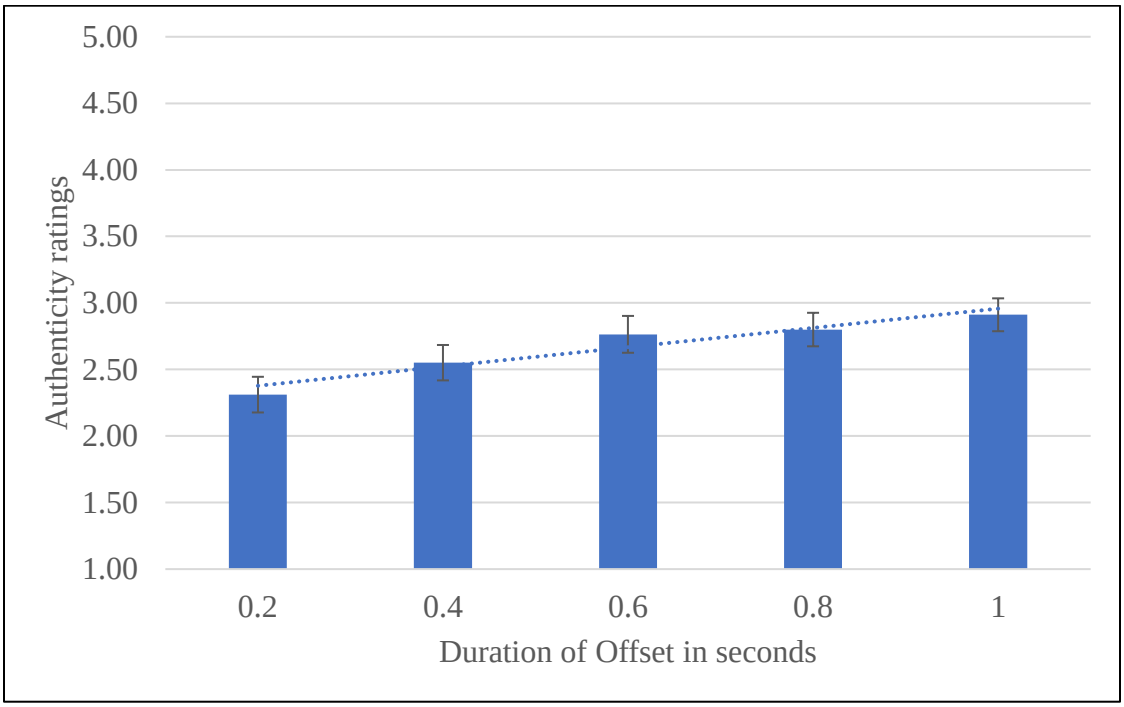


Figure 4. 2. The effect of Offset duration on authenticity ratings. Error bars represent standard errors of the mean.

Onset + offset duration

As with the offset condition, the participants were found to be sensitive to the duration of the smile when the duration of both offset and onset varied, $F(4, 224) = 18.07$, $p < .001$ ($R^2 = .075$). Multiple comparison tests between the control stimulus and the experimental stimuli reveal that smiles with onsets and offsets of 1000 ms were rated as more genuine than those with offsets of 200 ms ($p < 0.001$), and 400 ms ($p = 0.005$). No other significant differences were found (.6s, $p = 0.998$).

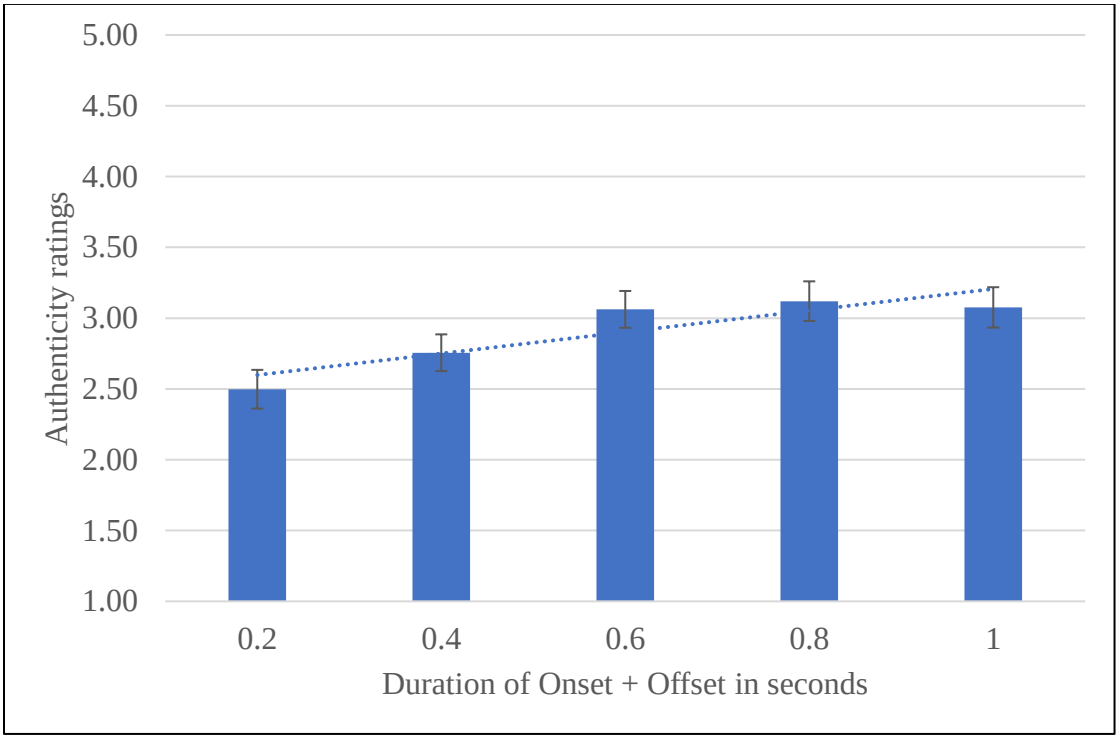


Figure 4. 3. The effect of Offset + Onset duration on authenticity ratings. Error bars represent standard errors of the mean.

Discussion

The goal of Study 4 was a simple but important one: to verify if the way the stimuli were constructed in previous studies could have had an effect on their results, and consequently to assess the replicability and generalisation of our findings. This study was therefore a replication of Study 1 with different stimuli, using the temporally reversed offset as the onset in the construction of the smiles used. As expected, the same patterns were obtained when it comes to the effect of the duration on the judgement of authenticity of smiles. No effect was observed for the onset condition, whereas the offset and offset + onset conditions both revealed an effect of the duration of the smiles. However, a minor difference was obtained compared to Study 1; In

order to perceive a significant difference in the perceived authenticity, the minimum duration contrast needed to be of 600 ms whereas a difference of 400 ms was reportedly needed in Study 1. However, this result could be an effect of the sample size. It is possible that the actual threshold is somewhere in between, on the order of 500 ms.

Chapter 6, Study 5 : Relationship between perceptual and judgement abilities

Objective

Our fifth study was done in an attempt to further investigate the relationship between participants' perceptive abilities to discriminate durations of smile phases and their judgement of authenticity of smiles. While we examined these abilities independently in the previous studies, we opted for both abilities to be tested with an intra-individual design in this study. Since we cannot say that participants with better perceptive abilities, e.g. the ability to detect temporal differences, are better at judging the authenticity of smiles based on our previous results, we wanted to establish a more direct relationship between the two variables. Based our previous results, we expected participants' duration-perception abilities to be linked with their authenticity ratings for the offset and the onset + offset conditions, but not for the onset condition.

Method

This fifth study is similar to Studies 1 and 3, but using a new measurement scale. In the first part, we examined the judgment of temporal differences in participants, and in the second, we evaluated their judgment of authenticity when the duration of smile phases varies. The stimuli were presented one by one to the participants, after which they had to make their judgment. For both conditions, a method similar to Magnitude Estimation (Stevens & Stevens, 1975) was used to measure their assessment of smile duration. The Magnitude Estimation method was developed by Stevens at Harvard university in the 1950's, to measure the perceived magnitude of a sensory change and more specifically in which participants make subjective judgements of the magnitude of stimuli by assigning them numerical values. Regarding the

judgment of authenticity condition, we used the same scale, the latter not having labels associated with each of the points of the scale. The conditions have been counterbalanced, and the trials are randomized.

Participants

The participants were 53 adults (41 females, 12 males) ranging from 17 to 26 years (*M*=18.77, *SD* = 1.85). All were recruited on a voluntary basis from the participant pool of a public university and received course credit for participating in the study. We performed an a priori power analysis using GPower (Faul, 2009) to estimate our sample size. This indicated that 61 participants to be sufficient. We could not finish our testing as it was cut short due to COVID-19 related restrictions.

Materials

The same stimuli as the ones used in Study 1 were used for this experiment. For each of the 2 conditions, 15 different smiles were shown to our participants. Five smiles where only the onset phase was modified, five smiles where only the offset phase was modified, and another five smiles where both onset and offset were manipulated. The duration parameters used were 200, 400, 600, 800, and 1000 ms.

Procedure

The task was done individually and under the same experimental conditions as our first four studies. However, since this study requires participants to make two different types of judgments, the instructions varied depending on the condition. The first task required them to focus on the duration of a stimulus, while the second task required them to pay attention to the authenticity of a stimulus. The order of conditions was counterbalanced. As in our previous

studies, participants were instructed to focus their attention on the manipulated phase of the smile, and then make their judgment by choosing the appropriate response on the screen. As seen in Annexe F, following the presentation of each stimulus, participants needed to register their answer by clicking on the bar that appeared on the screen, on which the location corresponded to a score, ranging from 1 (very short) to 100 (very long) for the first part of this experiment, or from 1 (least authentic) to 100 (very authentic) for the second part. Just below the answer bar, the numbers 0, 25, 50, 75 and 100 were indicated. Everything was automated using Superlab Pro software and no time limit was imposed on them. A full description of the instructions given to participants can also be found in Annexe F.

Results

Duration ratings

Each answer was calculated using the pixel location on the answer box presented at the screen after each stimulus. Since the software used the center of the image as $(x,y) = (0,0)$, and the answer bar was 1520 pixels long, we converted the pixel location to an answer between 0 and 100. The formula used was ((location+760)/1520)*100. For example, cursor clicks located at x = -760 corresponded to an answer of 0, a click located at $x = 0$ corresponded to an answer of 50, and a click located at $x = 760$ corresponded to 100. We used the scale 0 to 100 in order to have a finer scale than 1 to 5 and for a more intuitive results interpretation.

For this first part of the experiment, the mean subjective rating of duration was calculated for each objective duration and each phase condition (onset, offset, both). Because all assumptions of analysis of variance were met, we proceeded with a one-way repeated measures ANOVA with 5 levels to examine the effect of the objective duration on the perceived duration

of smiles, followed by multiple comparisons tests to examine the contrasts between each pair of conditions. In order to counteract the problem of multiple comparisons and control the error rate, we computed a multiplicity adjusted P value for each comparison. Below we discuss findings for onset, offset and onset+offset conditions in that order.

Onset condition

We found a significant main effect of onset duration, $F(4, 1468) = 21.18$, $p < .001$. As illustrated in Figure 5.1, the multiple comparison tests indicated that participants judged ON20-ON40 differently ($p < .001$), but did not do so with ON40-ON60 ($p > .999$), ON60-ON80 ($p = .21$) and ON80-ON100 ($p = .933$). This suggests that in general, participants judged a shorter smile as shorter or a longer smile as longer ($\eta^2 = 5.5\%$). However, while they perceived the 200 ms onset as shorter than the 400 ms onset, they struggled to perceive such a duration difference in the other 200 ms onsets contrasts, which suggests that the difference in the onsets had, in general, to be of 400 ms or more to produce a statistically significant effect on participants' duration ratings. All the other comparisons of 400, 600, and 800 ms duration differences were perceived as significantly different.

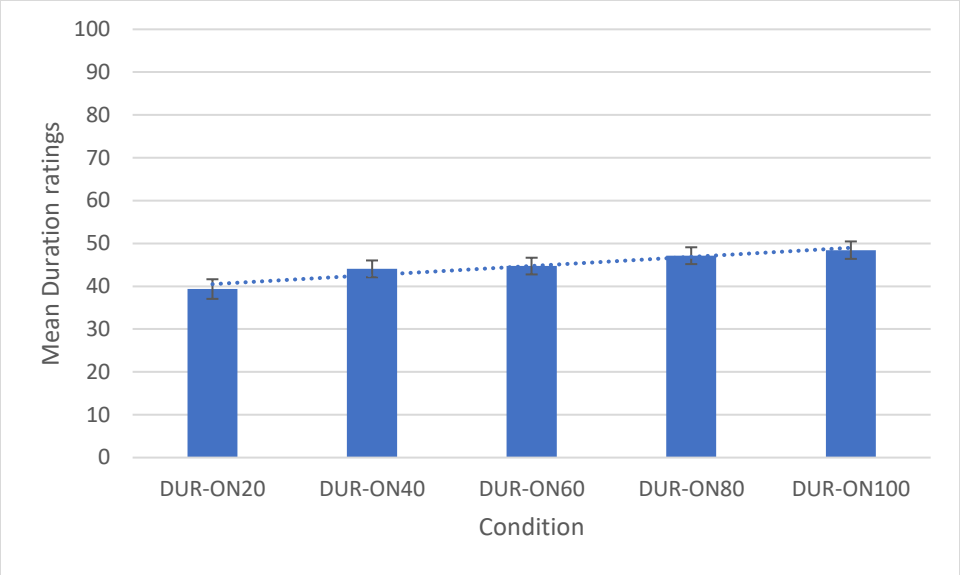


Figure 5. 1. The effect of Onset duration on authenticity ratings. Error bars represent standard errors of the mean.

Offset condition

As in the onset condition, we found a clear significant main effect of offset duration, $F(4, 1468) = 107.8$, $p < .001$. The duration accounts for 23% of the variation obtained in the duration ratings. The multiple comparison tests indicated that participants judged all duration differently, with the exception of OFF80 vs OFF100 ($p = .102$). Results indicate that participant were, in general, able to perceive difference of 200 ms in the offset. See Figure 5.2 below.

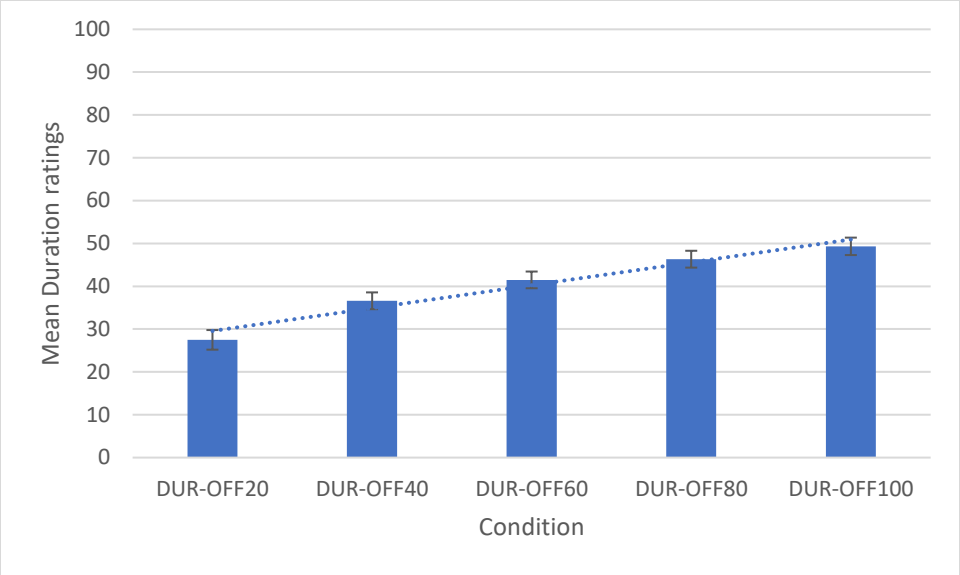


Figure 5. 2. The effect of Offset duration on authenticity ratings. Error bars represent standard errors of the mean.

Onset + offset condition

We also found a clear significant main effect of the onset + offset duration, $F(4, 1468) = 184.1$, $p < .001$, with an η^2 of .33. See Figure 5.3. The multiple comparison tests revealed that participants judged all duration differently, suggesting that participants were, in general, able to perceive difference of 200 ms in the onset + offset.

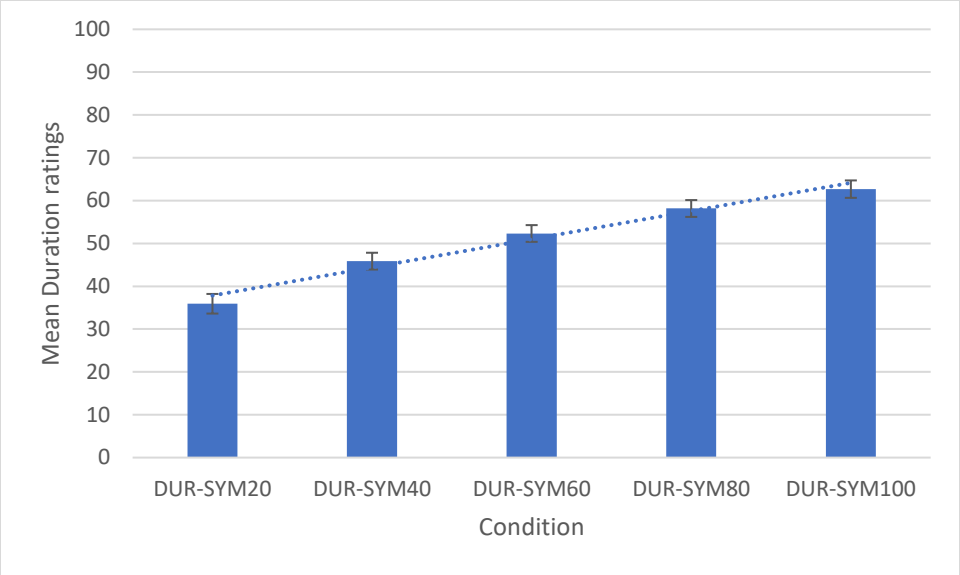


Figure 5. 3. The effect of Onset +Offset duration on duration ratings. Error bars represent standard errors of the mean.

Authenticity ratings

Each rating answer was calculated using the same method as used in the duration judgment task (see above) in order to obtain a value between 0 and 100.

For this second part of the experiment, the mean rating of authenticity was calculated for each duration and each condition (onset, offset, both). Because all assumptions of analysis of variance were met, we proceeded with a one-way repeated measures ANOVA with 5 levels to examine the effect of the duration on the perceived duration of smiles, followed by multiple comparisons tests to examine the contrasts between each pair of condition. We computed a multiplicity adjusted P value for each comparison in order to control for the error rate. Below we discuss findings for onset, offset and onset+offset conditions in that order.

Onset condition

As opposed to the duration conditions, we found no evidence of an effect of the onset duration on the authenticity ratings, $F(4, 1468) = 1.407$, $p = .23$ ($R^2 = .004$). Participants did not judge the authenticity differently in any of the onset duration. Surprisingly, all mean ratings were all very close, 52.27, 52.55, 53.99, 53.72, and 51.05, from ON20 to ON100 respectively, which indicates no pattern whatsoever and further validates the idea that participants do not use the onset of smiles to judge the authenticity. See Figure 5.4.

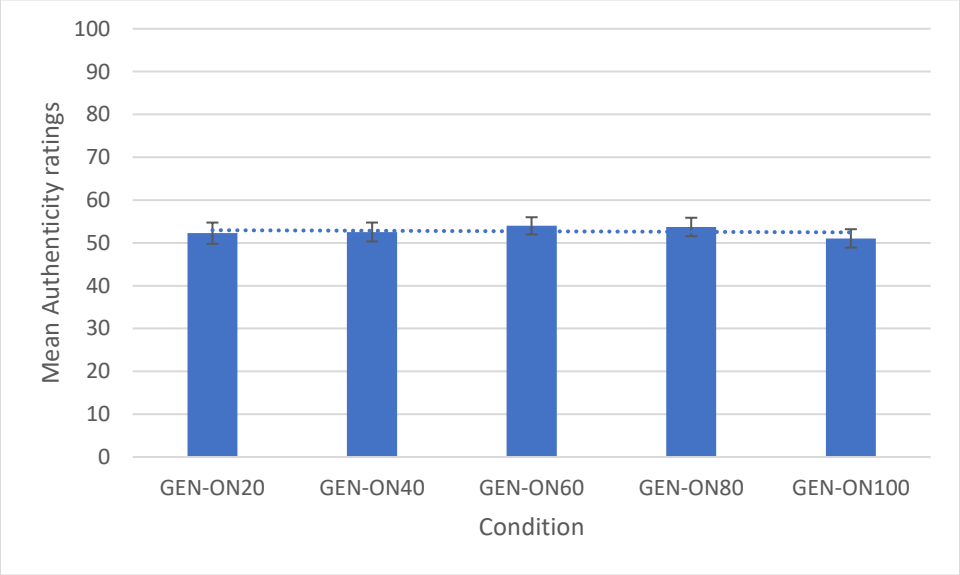


Figure 5. 4. The effect of Onset duration on authenticity ratings. Error bars represent standard errors of the mean.

Offset condition

For this condition, we found a significant main effect of offset duration on authenticity ratings, $F(4, 1468) = 73.00$, $p < .001$ with the proportion of variation in the authenticity ratings that can be attributed to the onset duration (r^2) being 16.59%. Multiple comparison tests indicated that participants judged almost all of the offset contrasts differently, with the exception of ON60 vs ON80 ($p = .114$) and ON80 vs ON100 ($p = .955$). We can infer that participants are able to use duration differences of the offset of anything between 200 and 800 ms to judge the authenticity differently, but that they seem to be struggling when the duration differences of offset are very small (200 ms). However, as seen in Figure 5.5, the general trend corresponds to what we obtained in our previous experiments.

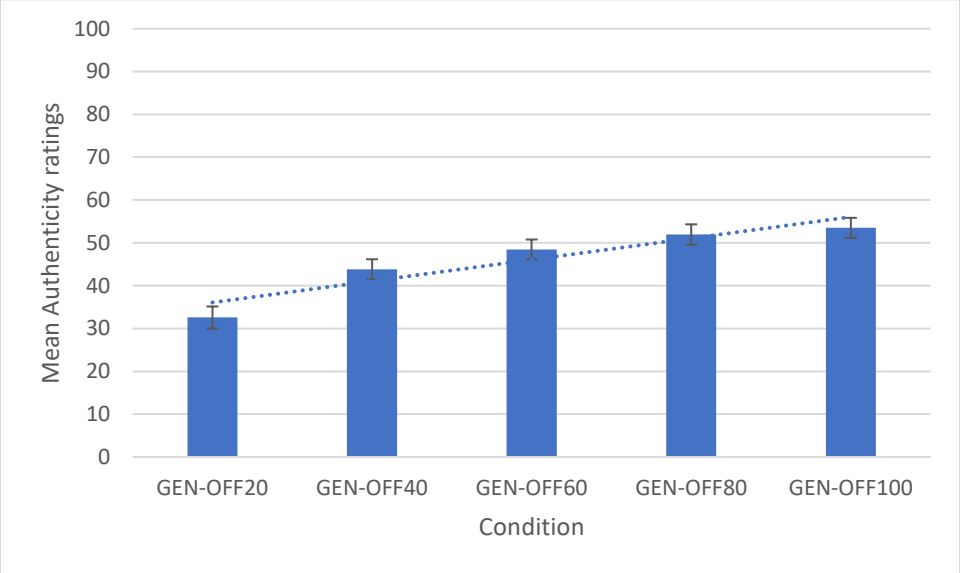


Figure 5. 5. The effect of Offset duration on authenticity ratings. Error bars represent standard errors of the mean.

Onset + offset condition

We also found a significant main effect of onset + offset duration on the authenticity ratings, $F(4, 1468) = 49.81$, $p < .001$, with a coefficient of determination (r^2) of 0.12, slightly less than obtained in the offset condition, which suggest that participants perceived longer onset + offsets smiles as more authentic. Multiple comparisons tests revealed that the authenticity ratings were perceived differently for almost all condition, with the exception of SYM60 vs SYM80 ($p = .99$), SYM60 vs SYM100 ($p = .843$) and SYM80 vs SYM100 ($p = .933$). This indicates that participants were able to perceive the 400 ms difference in the SYM20 vs SYM60 ($p < .001$) and the SYM40 vs SYM80 ($p < .001$). They were also able to perceive the 200 ms difference in one of the three contrasts (SYM20 vs SYM40, $p < .001$). See Figure 5.6 below.

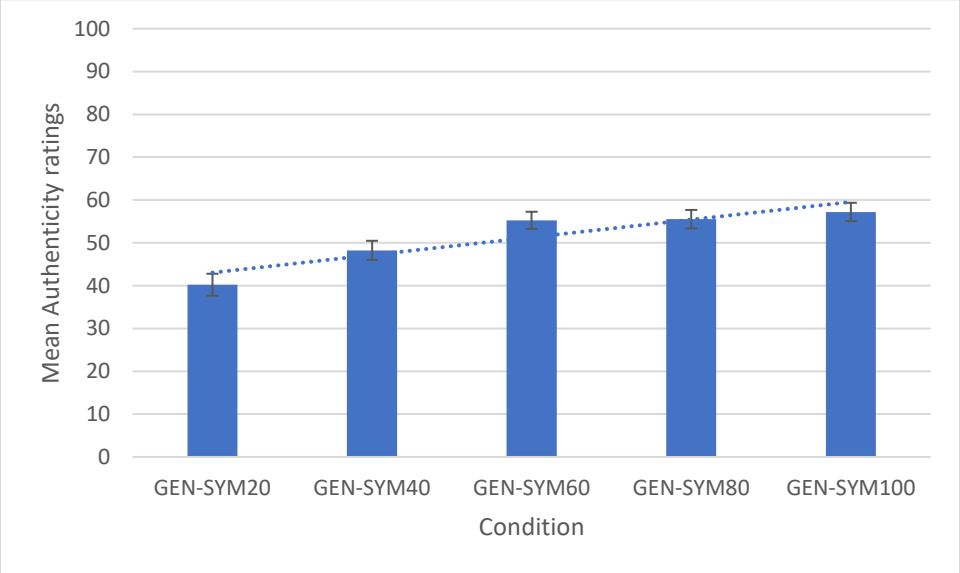


Figure 5. 6. The effect of Onset+Offset duration on authenticity ratings. Error bars represent standard errors of the mean.

Relationship between Duration and Authenticity ratings

The relationship between the duration and the authenticity ratings was analysed using Pearson's r correlation. For each participant, and for each condition, a regression coefficient was calculated for every trial between the objective durations and the duration ratings. The same was done with the objective durations and the genuineness ratings. We then proceeded with the correlation between both regression coefficients. The correlation matrix can be found in Table 5.1 below.

Surprisingly, and for the relationships that matter most to this experiment, no significant intra individuals correlations were found between the Onset Duration Ratings and the Onset Authenticity Ratings, $r(51) = -.04$, $p = .782$, nor was their a relationship between Offset Duration Ratings and the Offset Authenticity Ratings, $r(51) = .22$, $p = .121$. Similarly, there was no significant relationship between the Onset+Offset Duration Ratings and the Onset+Offset Authenticity Ratings, $r(51) = -.15$, $p = .318$. We expected to get such results for the onset condition, but expected a significant relationship for the offset and the onset+offset conditions. However, we did find a significant relationship between the onset+offset duration ratings and the offset authenticity ratings, $r(51) = .40$, $p = .003$. In regards to only the duration ratings, we also found a significant correlation between the offset duration ratings and the onset durations ratings, $r(51) = .35$, $p = .009$, as well as with the onset+offset duration ratings, $r(51) = .59$, $p < .001$. As for the authenticity ratings only, we found correlations between the onset and the onset+offset conditions, $r(51) = .47$, $p < .001$, and the offset and the onset+offset condition, $r(51) = .67$, $p < .001$. No other statistically significant correlations were found.

Table 5. 1. *Correlation matrix with confidence intervals*

Condition	1	2	3	4	5
1. Onset Duration					
2. Offset Duration	0.35** [.09, .57]				
3. Onset+Offset Duration	0.11 [-.17, .37]	0.59** [.38, .74]			
4. Onset Authenticity	-0.04 [-.31, .23]	-0.15 [-.40, .13]	-0.02 [-.29, .26]		
5. Offset Authenticity	-0.16 [-.41, .12]	0.22 [-.06, .46]	0.40** [.15, .61]	0.16 [-.11, .42]	
6. Onset+Offset Authenticity	-0.15 [-.41, .12]	-0.11 [-.37, .17]	0.14 [-.14, .40]	0.47** [.22, .65]	0.67** [.48, .79]

Note. Values in square brackets indicate the 95% confidence interval for each correlation.
**Indicates $p < 0.01$, two-tails.

Discussion

The goal of this study was to verify the relationship between participants' perceptive abilities to discriminate durations of smile phases and their judgement of authenticity of smiles and more precisely, we wanted to examine whether participants with better abilities to detect temporal differences are better at judging the authenticity of smiles. This was our first attempt at evaluating the relationship between their abilities in a within-subject design. We also opted to

use a different scale, which we thought would be harder for our participants, as opposed to the ones used in Study 1 and 4. This in turn would help us further replicate our findings.

Duration ratings task

The main objective of this task was to see if participants were as good as Study 2 in detecting the temporal differences between various smiles in order to find the relationship with their authenticity judgement abilities. Despite using a finer scale, we obtained the same patterns as in Study 2, showing participants are sensitive to duration changes in all the phases used in our experiments. They were able to judge smiles with a 400 ms or greater duration difference differently across all conditions. In addition, unlike Study 2, where participants were able to distinguish 200 ms duration difference between all onset conditions, they were able to do so only for the 200 ms and the 400 ms contrast in this experiment. A similar pattern was found for the offset duration condition, our results showing that participants are sensitive to the duration of the offset, and performed well at distinguishing all the duration changes, with the exception of the 200 ms and 400 ms contrast, which they did not judge differently. As for the onset+offset duration condition, our results show that participant are sensitive to a change in duration, and were able to see the difference between all pairs of duration. Overall, we replicated the same results as in Study 2. Our participants were very good, thought very slightly less, most likely because of the finer scale used, at detecting the duration changes in all phases of the smile, even when the difference was very small, ranging somewhere between 200 ms and 400 ms.

Authenticity ratings task

The objective of this task was to examine whether the duration of a genuine smile has an effect on its perceived authenticity in order to establish a relationship with the results obtained in

the previous task. Such an analysis would help us understand if participants with better perceptual abilities are also better at judging the authenticity of smiles. Our results are all in line with what we obtained in our previous studies, mainly that there is no effect of the onset duration on the perceived authenticity of smiles, but this effect exists when the duration of the offset phase of the smile varies, as well as for when the onset+offset phases are manipulated together. Specifically, for the offset condition, they were able to judge differently all contrast of 400 ms or greater, and were even able to judge the authenticity differently for as small as a 200 ms duration difference for some of the duration contrasts. A very similar pattern was found for the onset+offset condition, with the addition of participants not judging differently the 600 ms – 1000 ms contrast. Altogether, results suggest a duration difference of somewhere between 200 and 400 ms is needed in order to induce a difference in their authenticity ratings.

Relationship between their perceptual and judgement abilities

We did not find any significant intra-individual relationship between both abilities despite having the same interindividual effects as in Asselin and colleagues (2020) for the offset and onset+offset. Although this is a null result, this finding is nonetheless interesting, and while it may seem intuitively like a contradiction that there are interindividual effect and not intra-individual effects, it is in fact a well-known phenomenon. What this pattern of results means is that individual differences in how good a person is at seeing temporal differences are not linked to individual differences in how much their judgements of authenticity are linked to temporal differences. We observed a strong relationship between their ability to perceive the duration differences in the onset and their ability to perceive the duration differences in the offset, and idem between and their ability to perceive the duration differences in the offset and their ability to perceive the duration differences in the onset+offset together. However, this simply means

that people that are good at detecting temporal differences in one phase, are also good at doing it in the other phases of the smile. We found similar relationships for the authenticity judging ability, meaning people that are good at judging the authenticity of one phase of the smile are usually good at judging the authenticity of the other phase of the smile.

Because both phase duration manipulations are present in the onset + offset condition, it is possible that they were looking at the end of the smile because they were instructed to look at both the beginning and the end of the smile. If such an effect exists however, we would have found a relationship between the offset duration ratings task and the offset authenticity ratings tasks, or between the onset+offset duration ratings task and the onset+offset authenticity ratings tasks. It is plausible that our analysis lacked power, since our a priori power analysis suggested 61 participants and we were only able to test 53 for reasons described previously. It should also be noted that a bug in Superlab resulted the software failing to record the 4^{th} trial for a majority of the participants. We proceeded by removing the 4^{th} trials for all participants, meaning each of them ended up having 3 trials per condition instead of 4. Due to the nature of our task, it is possible that more data points per condition would have lowered the weight of the possible extremes on the regression coefficients and therefore gave us different results. Another possible explanation is Simpson's paradox, also called the Yule-Simpson effect (Wagner, 1982). The latter, particularly dangerous in causal inferences, is the phenomenon wherein a relationship appears in different groups, but disappears when these groups are combined.

Chapter 7: General Discussion

This thesis was realized with the objective to fill a void that we believe exist in the current literature, mainly that there was no agreement on the best methodology to use to answer our research question, and that there was also no clear answer regarding the effects of temporal dynamics on the judgement of authenticity of smiles. Working within the parameters established by the literature, we chose to manipulate onset and offset durations to the values used in our studies because there is no consensus in the literature, as the parameters used in the various studies are still chosen informally to this day, probably due to a lack of empirical data. Some researchers have also looked at this problem (Schmidt et al., 2003b), but past work has been sparse, likely due to the lack of technological means to easily and precisely manipulate the different phases of a smile. The span of values chosen also encompasses the values found by the most recent literature for genuine and false smiles (Schmidt et al., 2006a, 2006b, 2009).

We believe our stimulus construction method addressed a few issues raised by the literature, specifically the usage of artificial facial expressions; computer generated facial expressions were shown to be of questionable validity (Chamberland & Collin, 2020; Roesch et al., 2011) and we believe our video-editing methodology produced a level of ecological validity that was not reached in past literature. Consequently, we created this research program to differ methodologically from the most relevant previous studies (Krumhuber et al., 2007; Krumhuber & Kappas, 2005; Sato & Yoshikawa, 2004, 2009) in that we created stimuli of both genders that were photographic in nature and FACS validated. Furthermore, our stimuli were both spatially and temporally symmetrical and void of any neutral facial expression segments; This is important because it can be debated that a neutral facial display is only rarely seen in our daily lives and could potentially interfere with the participants' interpretation of the emotional facial

expressions. We decided to use Duchenne smiles to control its possible effect as some studies have suggested that the Duchenne markers could be a marker of smile intensity rather than smile authenticity (Girard et al., 2019; Krumhuber & Manstead, 2009). While we acknowledge that the FACS has its limitations, it is well established in the literature and using the FACS and the Duchenne smile allow us to easily compare our results with the literature.

The studies that we have carried out demonstrate unequivocally that the untrained individual is sensitive to temporal dynamics, even if this difference is quite small, and that there is also indeed an effect of the duration of the different phases of the smile on its judgment of authenticity. In our studies 1, 3, 4, and 5, the results show that a shorter smile is perceived to be less authentic, which is inconsistent with the past literature, and that participants do not use the onset phase to judge the authenticity of the smile (Bugental, 1986; Schmidt et al., 2003a, 2006, 2009; Cohn & Schmidt, 2004; Tarantili et al., 2005; Krumhuber & Kappas, 2005). This is based on the idea that genuine smiles with short onset/offset durations would provide a lower signal strength and could therefore be judged as more ambiguous and potentially less authentic. Study 4 also demonstrated that there is no morphological or dynamic cues in the onset or offset of smiles that is being used to judge the authenticity or duration of smiles, as using any of these phases in the construction of our stimuli gave us the same responses patterns.

Additionally, our results show that the offset, as well as the onset and offset together, are used to judge the authenticity of smiles which confirms the results of past studies, even though they were done with a different methodology and stimuli (Bugental, 1986; Schmidt et al., 2003a, 2006, 2009; Cohn & Schmidt, 2004; Tarantili et al., 2005; Krumhuber & Kappas, 2005). Our results confirm Ekman's (1980; 1982) proposition that the mean total duration of an authentic smile was around 4 seconds, and that the total duration of the authentic smile is correlated with

the degree of happiness (Ekman, Friesen, et al., 1980; Frank et al., 1993). Based on our results, we were able to refine their affirmation and propose that its ideal duration lies somewhere between 3000 and 4000 ms as our control smile duration is 3500 ms and is consistently rated as more genuine. Results also indicate that a minimum of 200 ms was generally needed to induce a judgement difference in duration ratings, and of somewhere between 200 and 400 ms to induce an authenticity judgement difference. The exact threshold appears to be between 200 and 400 ms meaning more studies could be done with finer variations e.g., 200, 250, 300, 350, 400 ms. We could eventually use this duration threshold to examine if training adults to be able to recognize the temporal differences make them better at judging authenticity.

Why is it that the offset duration produced an effect on the judgement of authenticity of smiles but not the onset? Although the present thesis cannot answer this question definitively as is, our main hypothesis, as explained in Asselin et al (2020), is that the beginning of a smile is most often mixed with other emotions due to its sudden occurrence in various context, whereas there isn't as much noise in the offset segment of the smile. We believe it is beneficial for adults to put more emphasis on controlling the beginning of a facial expression, or are just good at doing it for a short period of time due to cognitive resources limitations. When added to the fact that individuals can control the AUs involved in authentic smiles to a certain extent (Gosselin et al., 2002; Gunnery et al., 2013; Krumhuber et al., 2009; Schmidt & Cohn, 2001; Schmidt et al., 2006a) and that the ability to judge authenticity might be limited by perceptual factors like the temporal and spatial acuity of the human visual system, we are starting to have a good idea why it is possible that humans do not use the initial phase of a smile to judge its authenticity. While Study 5 aimed at giving us more information on the intraindividual abilities of participants in order to clarify the relationship between the perceptual and the authenticity judgement abilities,

and more specifically so for the onset condition, and for the reasons mentioned in Chapter 6, more research will need to be done.

Although this thesis attempts to address the main limitations of past literature, there are still a few that need to be mentioned. First, in the case of happiness, while expressed and recognized in all cultures (Ekman, 1971), we cannot necessarily generalize our results to other cultures as the interpretation of authenticity can differ significantly across cultures. Second, our samples all come from university student pools. However, and as shown by Ekman and Sullivan (1991), adults from various professional backgrounds did not differ in an authenticity judgment task, nothing leads us to believe that our tasks require a university education, and therefore we see no reason why our results should not be generalized to the entire adult population.

Another limitation concerns the experimental nature of our stimuli and setting of our studies. Although our studies bring significant progress in terms of ecological validity compared to the previous studies carried out, and that the internal validity and the fidelity is good within all of our studies, it is not perfect. Nothing can replace the interpretation of social smiles in a social context, but due to the necessary control required for the various parameters (action units, symmetry, intensity, and duration), and as it usually is for these kinds of studies, it is very difficult to create a perfect task. There is a considerable obstacle here that researchers in the field will need to address, because the trend is towards the use of artificially created stimuli due to the labor required to create stimuli using real human faces.

We also cannot underestimate the effect that individual differences among adults may have, may it be in terms of social and emotional skills or even life experience, on the ability to judge facial expressions' authenticity. For example, a study done by Ziebell, Collin, Weippert and Sokolov (2017) showed that adults with a history of self injuring are more sensitive to facial

expressions, and are better at distinguishing false smiles from authentic ones. Such a result could suggest that it will need to be controlled in further studies. A very interesting question that we could eventually address is whether or not people who are better at voluntarily producing genuine smiles are actually better at discriminating fake smiles from genuine ones.

A last limitation of our studies is the use of the onset+offset together. While we used it to give us more information when compared to the onset alone, or the offset alone condition, its use does not necessarily give us indication on how it is really used, and we cannot say with certainty if participants attended more to one phase or another. Participants could have looked mostly at the end of the smile, even though the beginning was also modified. We believe a good way to address this would be to replicate our studies with a visual tracker and examine where their gaze is at, in order to see if people spend more time - on smile - in the offset vs. the offset. We believe such a task would give us an indirect index of their gaze direction.

In conclusion, temporal dynamics, both in construction and in interpretation, are done much more easily than, for example, real-time interpretation of subtleties in asymmetry or action units or the regularity of facial expression. For this reason, our findings can provide important information for populations needing to judge the authenticity of various emotional expressions. Our findings also provide more empirical data to support the development of emotional expressions decoding software. This research program would first need to be replicated using other fundamental emotions in order to generalize the use of our findings, but we did provide some cues that could be used by clinical psychologists or by intelligence and security services for example. More research also be done to examine if training to increase adult's sensitivity to temporal dynamics can have an effect on their authenticity judgement abilities. Although it is believed that their temporal perceptual abilities are not easily modified (Chartrand & Gosselin,

2005), our results suggest it would be worth it to investigate this further. In light of the results obtained, the duration of the phases of the emotional facial expressions of smiles does seem to be a reliable indicator influencing the judgement of authenticity of the smile and further confirms the relevance of temporal dynamics in regards to the judgment of authenticity. However, there is still a lot of work to be done in order to clarify the relationship between the temporal dynamic and its judgment of the authenticity of the smile.

Références

Borod, J. C., & Caron, H. S. (1980). Facedness and emotion related to lateral dominance, sex and expression type. *Neuropsychologia*, *18*(2), 237–242. http://doi.org/10.1016/0028-3932(80)90070-6

Borod, J. C., Kent, J., Koff, E., Martin, C., & Alpert, M. (1988). Facial asymmetry while posing positive and negative emotions: Support for the right hemisphere hypothesis. *Neuropsychologia*, *26*(5), 759–764. http://doi.org/10.1016/0028-3932(88)90013-9

Brockmeier, B., & Ulrich, G. (1993). Asymmetries of Expressive Facial Movements During Experimentally-Induced Positive Vs Negative Mood States - a Video-Analytical Study. *Cognition & Emotion*, *7*(5), 393–405. http://doi.org/10.1080/02699939308409195

Brooks, V. B. (1986). The Neural Basis of Motor control. New York: Oxford University Press.

Bugental, D. B. (1986). Unmasking the "Polite Smile": Situational and Personal Determinants of Managed Affect in Adult-Child Interaction. *Personality and Social Psychology Bulletin*, *12*(1), 7–16. http://doi.org/10.1177/0146167286121001

Chamberland, C., Collin, C. (2020). An Evaluation of FaceGen Emotional Expressions: Emotional Expression Categorization of Computer-Generated and Photographic Faces with Similar Activation Unit Configurations. Manuscript submitted for publication.

Chartrand, J., & Gosselin, P. (2005). Judgment of the authenticity of smile and the detection of facial features. *Canadian Journal of Experimental Psychology*, 59(3), 179–189. https://doi.org/10.1037/h0087473

Cohn, J. F., & Schmidt, K. L. (2004). the Timing of Facial Motion in Posed and Spontaneous Smiles. *International Journal of Wavelets, Multiresolution and Information Processing*, *2*(2), 121–132. http://doi.org/10.1142/S021969130400041X

Ekman, P. & Friesen, W. (1971). Constants across cultures in the face and emotion. *Journal of Personality & Social Psychology*, 7(2), 124-129.

Ekman, P., & Friesen, W. V. (1972). Hand Movements. *Journal of Communication*, *22*(December), 353–374. http://doi.org/10.1111/j.1460-2466.1972.tb00163.x

Ekman, P., & Friesen, W. V. (1974). Detecting deception from the body or face. *Journal of Personality and Social Psychology*, *29*(3), 288–298. http://doi.org/10.1037/h0036006

Ekman, P., & Friesen, W. V. (1978). *Facial Action Coding System: A Technique for the Measurement of Facial Movement*. *Consulting Psychologists Press*.

Ekman, P. (1980). Asymmetry in facial expression. *Science*, *209*(4458), 833–836.

Ekman, P., & Friesen, W. V. (1982). Felt, false, and miserable smiles. *Journal of Nonverbal Behavior*, *6*(4), 238–252. http://doi.org/10.1007/BF00987191

Ekman, P., Friesen, W. V., & Hager, J. C. (2002). *Facial Action Coding System: The Manual*. *FACS*. http://doi.org/10.1016/j.msea.2004.04.064

Ekman, P., Friesen, W. V, & Ancoli, S. (1980). Facial Signs of Emotional Experience. *Journal of Personality and Social Psychology*, *39*(6), 1125–1134. http://doi.org/10.1037/h0077722

Ekman, P., Friesen, W. V, & O'Sullivan, M. (1988). Smiles when lying. *Journal of Personality and Social Psychology*, *54*(3), 414–420.

Ekman, P., Hager, J. C., & Friesen, W. V. (1981). The symmetry of emotional and deliberate facial actions. *Psychophysiology, 18*(2), 101–106.

Ekman, P., Roper, G., & Hager, J. (1980). Deliberate facial movement. *Child Development*, *51*(3), 886–891. http://doi.org/10.2307/1129478.

Ekman P, O'Sullivan M. Who can catch a liar? Am Psychol. 1991 Sep;46(9):913-20. doi: 10.1037//0003-066x.46.9.913.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*, 1149-1160.

Feldman, R., Jenkins, L., & Popoola, O. (1979). Detection of deception in adults and children via facial expressions. *Child Development, 50*(2), 350–355.

Frank, M. G., Ekman, P., & Friesen, W. V. (1993). Behavioral Markers and Recognizability of the Smile of Enjoyment. *Journal of Personality and Social Psychology*, *64*(1), 83–93.

Frank, R. H. (2004). Introducing moral emotions into models of rational choice. In A. S. R. Manstead, N. Frijda, & A. Fischer (Eds.), *Feelings and emotions* (pp. 422–440). New York: Cambridge University Press.

Fridlund, A. J. (1994). Human facial expression: An evolutionary view. Academic Press.

Gosselin, P., Kirouac, G., & Dore, F. Y. (1995). Components and recognition of facial expression in the communication of emotion by actors. *Journal of Personality and Social Psychology*, *68*(1), 83–96.

Gosselin, P., Perron, M., Legault, M., & Campanella, P. (2002). Children's and adults' knowledge of the distinction between enjoyment and nonenjoyment smiles. *Journal of Nonverbal Behavior*, *26*(2), 83–108.

Hager, J. C., & Ekman, P. (1985). The Asymmetry of Facial Actions Is Inconsistent with Models of Hemispheric Specialization. *What the Face Reveals: Basic and Applied Studies of Spontaneous Expression Using the Facial Action Coding System (FACS)*. http://doi.org/10.1093/acprof:oso/9780195179644.003.0003

Hager, J. C., & Ekman, P. (1997). The asymmetry of facial actions is inconsistent with models of hemispheric specialization. *What the Face Reveals: Basic and Applied Studies of Spontaneous Expression Using the Facial Action Coding System (FACS)*, 40–62. Retrieved from Oxford University Press

Hess, U., Kappas, A., McHugo, G. J., Kleck, R. E., & Lanzetta, J. T. (1989). An analysis of the encoding and decoding of spontaneous and posed smiles: The use of facial electromyography. *Journal of Nonverbal Behavior*, *13*(2), 121–137. http://doi.org/10.1007/BF00990794

Hess, U., & Kleck, R. E. (1990). Differentiating emotion elicited and deliberate emotional facial expressions. *European Journal of Social Psychology*, *20*(5), 369–385.

Hess, U., & Kleck, R. E. (1994a). The cues decoders use in attempting to differentiate emotion-elicited and posed facial expressions. *European Journal of Social Psychology*, *24*(3), 367–381. http://doi.org/10.1002/ejsp.2420240306

Hess, U., & Kleck, R. E. (1994b). The cues decoders use in attempting to differentiate emotion-

elicited and posed facial expressions. *European Journal of Social Psychology*, *24*(3), 367–381.

Asselin, D., Brosseau-Liard, P., Gosselin, P. et al. Effects of temporal dynamics on perceived authenticity of smiles. Atten Percept Psychophys 82, 3648–3657 (2020). https://doi.org/10.3758/s13414-020-02080-5

Johnston, L., Miles, L. and Macrae, C.N. (2010), Why are you smiling at me? Social functions of enjoyment and non-enjoyment smiles. British Journal of Social Psychology, 49: 107-127. https://doi.org/10.1348/014466609X412476

Kirouac, G., & Gosselin, P. (1994). Effet du canal de communication sur le jugement demotions ressenties et simulees. *Revue Canadienne Des Sciences Du Comportement*, *26*(1), 163–181.

Krumhuber, E. G., Kappas, a., & Manstead, a. S. R. (2013). Effects of Dynamic Aspects of Facial Expressions: A Review. *Emotion Review*, *5*(March 2016), 41–46. http://doi.org/10.1177/1754073912451349

Krumhuber, E. G., & Manstead, A. S. R. (2009). Can Duchenne smiles be feigned? New evidence on felt and false smiles. *Emotion (Washington, D.C.)*, *9*(6), 807–820. http://doi.org/10.1037/a0017844

Krumhuber, E., & Kappas, A. (2005). Moving smiles: The role of dynamic components for the perception of the genuineness of smiles. *Journal of Nonverbal Behavior*, *29*(1), 3–24. http://doi.org/10.1007/s10919-004-0887-x

Lynn, J. G., & Lynn, D. R. (1943). Smile and hand dominance in relation to basic modes of adaptation. *Journal of Abnormal and Social Psychology*, *38*(2), 250–276.

http://doi.org/10.1037/h0053547

O'Sullivan, M., Ekman, P., & Friesen, W. V. (1988). The effect of comparisons on detecting deceit. *Journal of Nonverbal Behavior, 12*(3), 203–215. http://doi.org/10.1007/BF00987488

Okamoto, H., Haraguchi, S., & Takada, K. (2010). Laterality of asymmetry in movements of the corners of the mouth during voluntary smile. *Angle Orthodontist*, *80*(2), 223–229. http://doi.org/10.2319/021809-104.1

Owren, M. J., & Bachorowski, J.-A. (2001). The evolution of emotional experience: A "selfish-gene" account of smiling and laughter in early hominids and humans. In T. J. M. G. A. Bonanno (Ed.), *Emotions: Currrent issues and future directions* (pp. 152–191). New York, NY, US: Guilford Press.

Rosenberg, E., & Ekman, P. (1994). Coherence between expressive and experiental systems in emotions. *Cognition and Emotion*, *8*(February), 201–230. http://doi.org/10.1080/02699939408408938

Ruch, W. (1995). Will the real relationsihp between facial expressoin and affective experience please stand up: The case of exhiliration. *Cognition and Emotion*, *9*(February), 33–58. http://doi.org/10.1080/02699939508408964

Stevens, S., & Stevens, G. (1975). Psychophysics : Introduction to Its Perceptual , Neural , and Social Prospects. *The American Journal of Psychology*, *88*(4), 677–684.

Sato, W., & Yoshikawa, S. (2004). The dynamic aspects of emotional facial expressions. *Cognition & Emotion*, *18*(5), 701–710. http://doi.org/10.1080/02699930341000176

Schmidt, K. L., Ambadar, Z., Cohn, J. F., & Reed, L. I. (2006). Movement differences between deliberate and spontaneous facial expressions: Zygomaticus major action in smiling. *Journal of Nonverbal Behavior*, *30*(1), 37–52. http://doi.org/10.1007/s10919-005-0003-x

Schmidt, K. L., Bhattacharya, S., & Denlinger, R. (2009). Comparison of deliberate and spontaneous facial movement in smiles and eyebrow raises. *Journal of Nonverbal Behavior*, *33*(1), 35–45. http://doi.org/10.1007/s10919-008-0058-6

Schmidt, K. L., Cohn, J. F., & Tian, Y. (2003a). Signal characteristics of spontaneous facial expressions: Automatic movement in solitary and social smiles. *Biological Psychology*, *65*(1), 49–66. http://doi.org/10.1016/S0301-0511(03)00098-X

Schmidt, K. L., Cohn, J. F., & Tian, Y. (2003b). Signal characteristics of spontaneous facial expressions: Automatic movement in solitary and social smiles. *Biological Psychology*, *65*(1), 49–66.

Schmidt, K. L., Liu, Y., & Cohn, J. F. (2006). The role of structural facial asymmetry in asymmetry of peak facial expressions. *Laterality*, *11*(September 2003), 540–561. http://doi.org/10.1080/13576500600832758

Seidler, J.; Vondráček, J. Í.; Saxl, I. (2000). "The life and work of Zbyněk Šidák (1933–1999)". Applications of Mathematics. **45** (5): 321. doi:10.1023/A:1022238410461.

Sidak, Z. K. (1967). "Rectangular Confidence Regions for the Means of Multivariate Normal Distributions". *Journal of the American Statistical Association*. **62** (318): 626–633. doi:10.1080/01621459.1967.10482935

Sirota, A. D., & Schwartz, G. E. (1982). Facial muscle patterning lateralization during elation

and depression imagery. *Journal of Abnormal Psychology*, *91*(1), 25–34. http://doi.org/10.1037/0021-843X.91.1.25

Tarantili, V. V., Halazonetis, D. J., & Spyropoulos, M. N. (2005). The spontaneous smile in dynamic motion. *American Journal of Orthodontics and Dentofacial Orthopedics*, *128*(1), 8–15. http://doi.org/10.1016/j.ajodo.2004.03.042

Wagner, C. H. (1982). Simpson's Paradox in Real Life. The American Statistician, 36(1), 46. https://doi.org/10.2307/2684093

Wang, S., Wu, C., & Ji, Q. (2016). Capturing global spatial patterns for distinguishing posed and spontaneous expressions. Computer Vision and Image Understanding, 147, 69–76. https://doi.org/10.1016/j.cviu.2015.08.007

Weiss, F., Blum, G. S., & Gleberman, L. (1987). Anatomically based measurement of facial expressions in simulated versus hypnotically induced affect. *Motivation and Emotion*, *11*(1), 67–81. http://doi.org/10.1007/BF00992214

Ziebell, L., Collin, C. A, Weippert, M., & Sokolov, M. (2017). Categorization of Emotional Facial Expressions in Humans with a History of Non-suicidal Self-injury. International Journal of Comparative Psychology, 30.

ANNEXES

Annexe A

Formulaires de consentement

Formulaire de consentement pour adulte

Nom du chercheur : David Asselin, Doctorant, École de psychologie, Université d'Ottawa, 136 Jean-Jacques Lussier, pièce 5061, Ottawa, ON, K1N 6N5.
Invitation à participer: Je suis invité(e) à participer une recherche menée par David Asselin qui porte sur le décodage des expressions faciales.
But de l'étude: Le but est d'étudier l'interprétation des expressions faciales des émotions. Ma participation consistera à regarder des expressions faciales présentées sur un écran d'ordinateur et à porter un jugement sur ce que pense la personne qui fait l'expression. L'étude requiert la participation à une seule séance de 30 minutes et a lieu dans le laboratoire du responsable de la recherche sur le campus central de l'Université d'Ottawa.
Risques: Je comprends que ma participation à cette recherche implique que je réponde à des questions en rapport avec les expressions faciales. J'ai reçu l'assurance du chercheur que ma participation ne comporte pas de risque d'inconfort qui sont plus élevés que ceux que je peux rencontrer dans la vie quotidienne.
Bienfaits: Ma participation à cette recherche aura pour effet de faire progresser les connaissances scientifiques dans le domaine de la communication des émotions.
Confidentialité et anonymat: J'ai l'assurance du chercheur que l'information que je partagerai avec lui restera strictement confidentielle. Je m'attends à ce que le contenu ne soit utilisé que pour la recherche et selon le respect de la confidentialité. Seuls le responsable de la recherche et ses assistants de recherche auront accès aux renseignements fournis et ces derniers seront conservés dans le laboratoire de recherche. L'anonymat est garanti de la façon suivante. Mon nom n'apparaîtra pas dans les fichiers de résultats afin d'assurer l'anonymat. Les résultats de l'étude ne serviront qu'à des fins de recherche et seront présentés sous forme de moyennes de groupe.
Conservation des données: Les données recueillies sur support électronique seront conservées de façon sécuritaire dans le laboratoire de recherche du chercheur. Les données seront conservées pendant dix ans après la publication des résultats et seront ensuite détruites.
Participation volontaire: Ma participation à la recherche est volontaire et je suis libre de me retirer en tout temps, et/ou refuser de répondre à certaines questions, sans subir de conséquences négatives. Si je choisis de me retirer de l'étude, les données recueillies jusqu'à ce moment seront détruites immédiatement après mon départ du laboratoire de recherche.

Acceptation: Je, _____(nom du participant), accepte de participer à cette recherche menée par David Asselin, de l'École de psychologie.

Pour tout renseignement additionnel concernant cette étude, je peux communiquer avec le chercheur.

Pour tout renseignement sur les aspects éthiques de cette recherche, je peux m'adresser au Responsable de l'éthique en recherche, Université d'Ottawa, Pavillon Tabaret, 550, rue Cumberland, pièce 154, Ottawa, ON K1N 6N5. Tél.: (613) 562-5387. Courriel : ethics@uottawa.ca

Il y a deux copies du formulaire de consentement, dont une copie que je peux garder.

Signature du participant: _____ Date: _____

Témoin (nécessaire dans le cas où le participant serait illettré, aveugle, etc.):
_____ Date: _____

Si vous êtes intéressé(e) à recevoir une copie du résumé des résultats de l'étude, veuillez indiquer votre adresse postale ou votre adresse électronique:

Consent form

Consent Form for Adults Participants

Main Researcher : David Asselin, PhD Candidate, School of Psychology, University of Ottawa, 136 Jean-Jacques Lussier, room 3089, Ottawa, ON, K1N 6N5.
Participation: I am invited to participate to a study realized by David Asselin about the decoding of emotional facial expressions.
Goal of study: The goal of this study is to examine the interpretation of emotional facial expressions. My participation consists of looking at facial expressions and judging various parameters. The study requires 30 minutes of my time and is held in a research laboratory at the University of Ottawa.
Risks: I understand that my participation in this study involves that I answer questions about facial expressions. I am informed that there are no more risks than what I would encounter on a daily basis.
Benefits: My participation to this study will help advance the knowledge in the field of emotional communication.
Confidentiality: I am informed that my information will remain stricly confidential. The results will be used solely for this research. Only the researchers involved with this study will have access to the information provided through this study and it will remain in the research laboratory. My informations will remain anonymous and will not appear in the results or any publications.
Data storage: The data collected through this study will be securely saved on an electronic device and will remain inside the research laboratory. They will be kept for 10 years after the publication of the results and will be destroyed afterwards.
Voluntary participation: My participation to this study is on a voluntary basis and I am free to withdraw myself from it at any time, to refuse to answer any questions with no negative consequences. If I withdraw from participating in this study, the data collected will be immediately destroyed once I leave the research laboratory.

Acceptation: I, _____(participant name), accept to participate in this study realized by David Asselin, from the School of Psychology.

I can contact the main researcher for any additional information.

For any information regarding ethics, I can reach the person responsible for Ethics in Research, University of Ottawa, Pavillon Tabaret, 550, Cumberland, room 154, Ottawa, ON K1N 6N5. Tel.: (613) 562-5387. Email : ethics@uottawa.ca

Participant signature: _____ Date: _____

Witness (if needed.): _____ Date: _____

If you would like to receive a copy of this consent form, or if you would like to see a summary of the results of this study, please indicate your email adress : _____

Annexe B

Étude 1

Informations générales

Pour décrire convenablement notre échantillon de participants, nous avons besoin des informations suivantes:

Quel est votre âge : ____ ans

Quel est votre sexe : masculin ___ féminin ___

Quel est votre programme d'étude à l'Université : _____

Instructions aux participants

Bonjour et merci de participer à cette étude. Nous nous intéressons à l'interprétation que vous faites des expressions du visage. Dans certaines situations, une personne peut être contente et le montrer ouvertement à une autre personne. Elle exprime spontanément sa joie. Dans un tel cas, nous dirons que son sourire est authentique. Une personne peut aussi faire semblant d'être contente dans certaines situations. Elle sourit, mais elle ne ressent pas de joie. Elle veut simplement faire croire à une autre personne qu'elle est contente même si ce n'est pas le cas. Dans un tel cas, son sourire peut paraître plus ou moins authentique.

Vous verrez dans les prochaines minutes une série de sourires produits par des personnes. Plus exactement, vous verrez différents sourires dont la durée varie. Nous voulons savoir, sur une échelle de 1 à 5, à quel degré vous jugez ces sourires sincères.

Soyez bien attentifs!

Partie Onset

- Lors de cette partie, nous aimerions que vous prêtiez attention au début du sourire, soit entre le moment où le visage est neutre et le moment où le sourire est le plus intense.
- Pour répondre, vous cliquez simplement sur le bouton correspondant à votre jugement du degré de sincérité.
- Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à débuter l'expérimentation.

Partie Offset

- Lors de cette partie, nous aimerions que vous prêtiez attention à la fin du sourire, soit entre le moment où le visage est le plus intense et le moment où le visage est neutre.
- Pour répondre, vous cliquez simplement sur le bouton correspondant à votre jugement du degré de sincérité.
- Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à poursuivre l'expérimentation.

Partie Apex

- Lors de cette partie, nous aimerions que vous prêtiez attention à toute la durée du sourire.

- Pour répondre, vous cliquez simplement sur le bouton correspondant à votre jugement du degré de sincérité.
- Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à poursuivre l'expérimentation.

Choix de réponse

Annexe C

Étude 2

Instructions aux participants :

Informations générales

Pour décrire convenablement notre échantillon de participants, nous avons besoin des informations suivantes:

Quel est votre âge : ____ ans

Quel est votre sexe : masculin ___ féminin ___

Quel est votre programme d'étude à l'Université : _____

Instructions aux participants

Partie 1

Bonjour et merci de participer à cette étude. Nous nous intéressons à l'interprétation que vous faites des expressions du visage. Dans certaines situations, une personne peut être contente et le montrer ouvertement à une autre personne. Elle exprime spontanément sa joie. Dans un tel cas, nous dirons que son sourire est authentique. Une personne peut aussi faire semblant d'être contente dans certaines situations. Elle sourit, mais elle ne ressent pas de joie. Elle veut simplement faire croire à une autre personne qu'elle est contente même si ce n'est pas le cas. Dans un tel cas, son sourire peut paraître plus ou moins authentique.

Vous verrez dans les prochaines minutes une série de sourires produits par des personnes. Plus exactement, vous verrez deux sourires présentés l'un à la suite de l'autre par la même personne. Nous voulons savoir lequel des deux sourires vous semble le plus long.

Partie Onset

Nous aimerions que vous prêtiez attention **au début du sourire**, soit entre le moment où le visage est neutre et le moment où le sourire est le plus intense.

Pour répondre, vous cliquez simplement sur le bouton 1 si le premier sourire vous semble le plus authentique et sur le bouton 2 si le deuxième sourire est celui qui vous semble le plus authentique.

Partie Offset

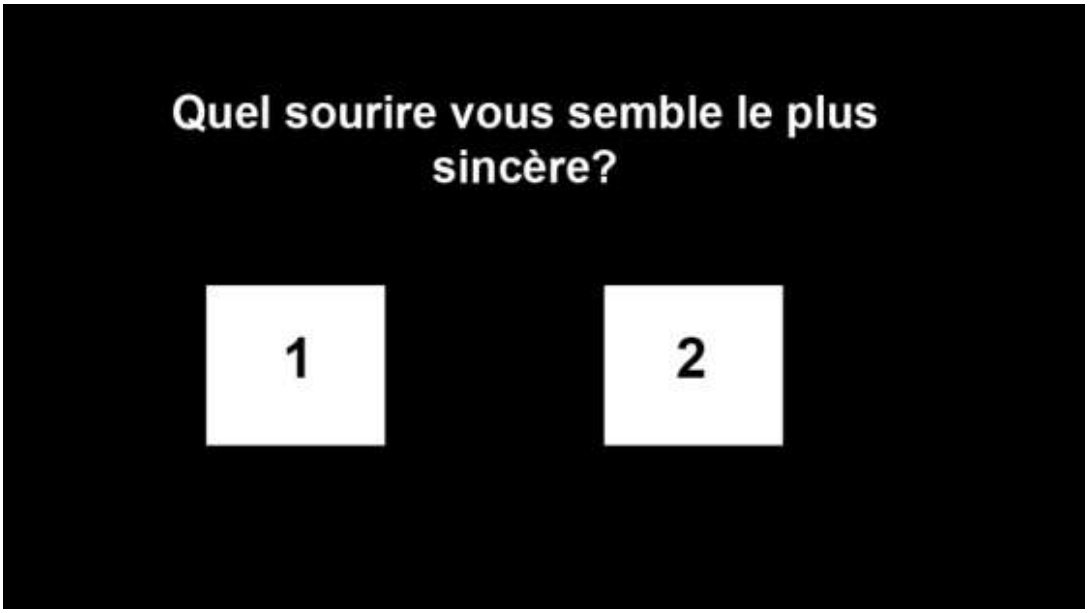
Nous aimerions que vous prêtiez attention **à la fin du sourire**, soit entre le moment où le visage est le plus intense et le moment où le visage est neutre.

Pour répondre, vous cliquez simplement sur le bouton 1 si le premier sourire vous semble le plus authentique et sur le bouton 2 si le deuxième sourire est celui qui vous semble le plus authentique.

Partie Apex

Nous aimerions que vous prêtiez attention **au moment où le sourire est le plus intense**. Pour répondre, vous cliquez simplement sur le bouton 1 si le premier sourire vous semble le plus authentique et sur le bouton 2 si le deuxième sourire est celui qui vous semble le plus authentique.

Choix de réponses



Annexe D

Étude 3

Informations générales

Pour décrire convenablement notre échantillon de participants, nous avons besoin des informations suivantes:

Quel est votre âge : ____ ans

Quel est votre sexe : masculin ___ féminin ___

Quel est votre programme d'étude à l'Université : _____

Instructions aux participants

Bonjour et merci de participer à cette étude. Nous nous intéressons à l'interprétation que vous faites des expressions du visage. Dans certaines situations, une personne peut être contente et le montrer ouvertement à une autre personne. Elle exprime spontanément sa joie. Dans un tel cas, nous dirons que son sourire est authentique. Une personne peut aussi faire semblant d'être contente dans certaines situations. Elle sourit, mais elle ne ressent pas de joie. Elle veut simplement faire croire à une autre personne qu'elle est contente même si ce n'est pas le cas. Dans un tel cas, son sourire peut paraître plus ou moins authentique.

Vous verrez dans les prochaines minutes une série de sourires produits par des personnes. Plus exactement, vous verrez deux sourires présentés l'un à la suite de l'autre par la même personne. Nous voulons savoir lequel des deux sourires vous semble le plus authentique.

Partie Onset

Nous aimerions que vous prêtiez attention **au début du sourire**, soit entre le moment où le visage est neutre et le moment où le sourire est le plus intense.

Pour répondre, vous cliquez simplement sur le bouton 1 si le premier sourire vous semble le plus authentique et sur le bouton 2 si le deuxième sourire est celui qui vous semble le plus authentique.

Partie Offset

Nous aimerions que vous prêtiez attention **à la fin du sourire**, soit entre le moment où le visage est le plus intense et le moment où le visage est neutre.

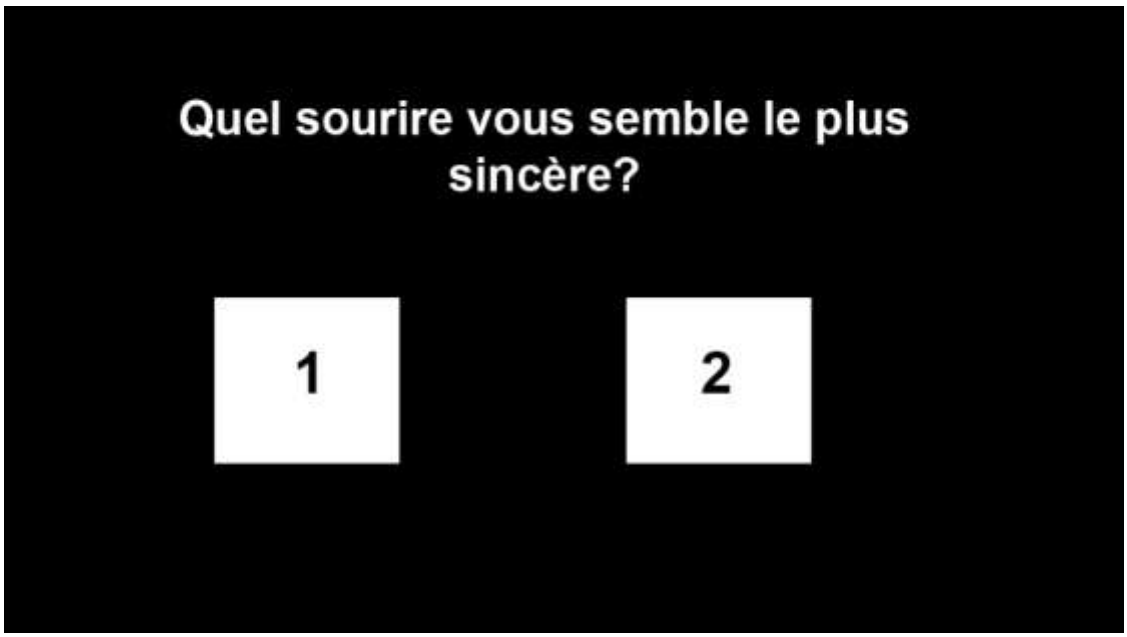
Pour répondre, vous cliquez simplement sur le bouton 1 si le premier sourire vous semble le plus authentique et sur le bouton 2 si le deuxième sourire est celui qui vous semble le plus authentique.

Partie Apex

Nous aimerions que vous prêtiez attention **au moment où le sourire est le plus intense**. Pour répondre, vous cliquez simplement sur le bouton 1 si le premier sourire vous semble le plus

authentique et sur le bouton 2 si le deuxième sourire est celui qui vous semble le plus authentique.

Choix de réponse :



Annexe E

Étude 4

Préambule

Nous sollicitons votre participation à une étude qui s'intéresse à la communication non verbale, plus particulièrement au décodage des expressions faciales des émotions. Cette étude est effectuée par David Asselin sous la direction de Dr. Patricia Brosseau-Liard et Dr. Charles Collin, professeurs à l'École de Psychologie. La tâche implique une seule session de 20 minutes.

La participation à ce projet est complètement volontaire et vous êtes libre d'y mettre fin à n'importe quel moment, sans encourir de pénalisation sous aucune forme. L'anonymat et la confidentialité des renseignements fournis seront rigoureusement respectés. Seul le responsable de la recherche aura accès aux renseignements fournis et ces derniers seront conservés en lieu sûr. Les résultats obtenus dans le cadre de cette recherche ne serviront qu'à des fins de recherche et seront traités sous forme de moyenne de groupe. Les données de la recherche seront conservées pendant les cinq ans qui suivront la publication des résultats de la recherche. Il vous sera possible de recevoir une copie du résumé des résultats de la recherche vers le mois d'avril 2014.

Nous vous remercions de votre attention.

Informations générales

Pour décrire convenablement notre échantillon de participants, nous avons besoin des informations suivantes:

Quel est votre âge?

Inscrivez votre âge à l'aide des chiffres du clavier.

Appuyez sur la touche 'z' pour continuer.

Quel est votre sexe?

Appuyez sur la touche "H" pour Homme.

Appuyez sur la touche "F" pour Femme.

Quel est votre programme d'étude?

Inscrivez votre programme en utilisant le clavier.

Instructions aux participants

Bonjour et merci de participer à cette étude. Nous nous intéressons à l'interprétation que vous faites des expressions du visage.

Dans certaines situations, une personne peut être contente et le montrer ouvertement à une autre personne. Elle exprime spontanément sa joie. Dans un tel cas, nous dirons que son sourire est authentique. Une personne peut aussi faire semblant d'être contente dans certaines situations. Elle sourit, mais elle ne ressent pas de joie. Elle veut simplement faire croire à une autre personne qu'elle est contente même si ce n'est pas le cas. Dans un tel cas, son sourire peut paraître plus ou moins authentique.

Vous verrez dans les prochaines minutes une série de sourires produits par des personnes. Plus exactement, vous verrez différents sourires dont la durée varie. Nous voulons savoir, sur une échelle de 1 à 5, à quel degré vous jugez ces sourires sincères.

Soyez bien attentifs!

Appuyez sur la touche "y" pour continuer.

PARTIE 1

Lors de cette partie, nous aimerions que vous prêtiez attention au début du sourire, soit entre le moment où le visage est neutre et le moment où le sourire est le plus intense.

Pour répondre, vous cliquez simplement sur le bouton correspondant à votre jugement du degré de sincérité.

Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à poursuivre l'expérimentation.

PARTIE 2

Lors de cette partie, nous aimerions que vous prêtiez attention à la fin du sourire, soit entre le moment où le visage est le plus intense et le moment où le visage est neutre.

Pour répondre, vous cliquez simplement sur le bouton correspondant à votre jugement du degré de sincérité.

Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à poursuivre l'expérimentation.

PARTIE 3

Lors de cette partie, nous aimerions que vous prêtiez attention à toute la durée du sourire.

Pour répondre, vous cliquez simplement sur le bouton correspondant à votre jugement du degré de sincérité.

Pour répondre, vous cliquez simplement sur le bouton correspondant à votre jugement du degré de sincérité.

Annexe F

Étude 5

Instructions aux participants

Bonjour et merci de participer à cette étude. Nous sollicitons votre participation à une étude qui s'intéresse à la communication non verbale, plus particulièrement au décodage des expressions faciales des émotions. Cette étude est effectuée sous la direction de Dr. Patricia Brosseau-Liard et Dr. Charles Collin, professeurs à l'École de Psychologie. La tâche implique une seule session d'environ 20 minutes.

Nous vous remercions de votre attention.

Appuyez sur la touche 'z' pour continuer.

Thank you for participating in this study about nonverbal communication and more specifically the decoding of emotional facial expressions. This research is realized under the supervision of Dr. Patricia Brosseau-Liard and Dr. Charles Collin, professors at the School of Psychology. The task involves one session of about 20 minutes.

Thank you for your attention.

Press on the 'z' key to continue.

Explication du contexte

Dans certaines situations, une personne peut être contente et le montrer ouvertement à une autre personne. Elle exprime spontanément sa joie. Dans un tel cas, nous dirons que son sourire est authentique. Une personne peut aussi faire semblant d'être contente dans certaines situations. Elle sourit, mais elle ne ressent pas de joie. Elle veut simplement faire croire à une autre personne qu'elle est contente même si ce n'est pas le cas. Dans un tel cas, son sourire peut paraître plus ou moins authentique.

Vous verrez dans les prochaines minutes une série de sourires produits par des personnes. Plus exactement, vous verrez différents sourires dont la durée varie. Nous voulons savoir, sur une échelle de 1 à 100, à quel degré vous juger la durée et la sincérité de ces sourires.

Soyez bien attentifs!

Appuyez sur la touche "y" pour continuer.

We examine the interpretation of facial expressions. In certain situations, a person can be happy and spontaneously show it. In such cases, we would say that her smile is genuine. In a different context, a person can pretend to be happy. He/she would smile without feeling any happiness, in which case we would say the smile is more or less genuine. In this study, we ask you to judge the authenticity of such smiles.

In the next minutes, you will be shown a series of smiles produced by different people that will vary in their duration. We ask you to judge, from a 1 to 100 scale, the duration and the genuineness of those smiles.

Please be very attentive!

Press on the 'z' key to continue.

- Première partie -

Lors de cette partie de l'étude, vous devez juger la DURÉE des sourire.

Bonne chance!

Appuyez sur la touche "y" pour continuer.

-Part One –

During this part, you need to judge the DURATION of the smiles.

Good luck!

Press on the 'z' key to continue.

PARTIE 1-A

Lors de cette partie, nous aimerions que vous prêtiez attention au début du sourire, soit entre le moment où le visage est neutre et le moment où le sourire est le plus intense.

Pour répondre, vous cliquez simplement à l'endroit correspondant à votre jugement de la durée du sourire.

Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à débuter l'expérimentation.

PART 1-A

For this part, you need to pay attention to the beginning of the smile, which means from the moment where the facial expression is neutral to when it is most intense.

To answer, you simply need to click at the appropriate location on the scale below.

Press on the 'y' key once you are ready to continue the experimentation.

PARTIE 1-B

Lors de cette partie, nous aimerions que vous prêtiez attention à la fin du sourire, soit entre le moment où le visage est le plus intense et le moment où le visage est neutre.

Pour répondre, vous cliquez simplement à l'endroit correspondant à votre jugement de la durée du sourire.

Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à poursuivre l'expérimentation.

PART 1-B

For this part, you need to pay attention to the end of the smile, which means from the moment where the facial expression is most intense to when it is neutral.

To answer, you simply need to click at the appropriate location on the scale below.

Press on the 'y' key once you are ready to continue the experimentation.

PARTIE 1-C

Lors de cette partie, nous aimerions que vous prêtiez attention à toute la durée du sourire.

Pour répondre, vous cliquez simplement à l'endroit correspondant à votre jugement de la durée du sourire.

Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à poursuivre l'expérimentation.

PART 1-C

For this part, you need to pay attention to the whole smile.

To answer, you simply need to click at the appropriate location on the scale below.

Press on the 'y' key once you are ready to continue the experimentation.

- DEUXIÈME PARTIE -

Bravo! Vous avez complété la première partie de l'étude.

Maintenant, plutôt que de juger la durée des sourires, vous devez juger son AUTHENTICITÉ.

Bonne chance!

Appuyez sur la touche "y" pour continuer.

- PART TWO -

Congratulations! You have completed the first part of the study.

Now, instead of judging the duration of the smiles, you need to judge their GENUINENESS.

Good luck!

Press on the 'y' key to continue.

PARTIE 2-A

Lors de cette partie, nous aimerions que vous prêtiez attention au début du sourire, soit entre le moment où le visage est neutre et le moment où le sourire est le plus intense.

Pour répondre, vous cliquez simplement à l'endroit correspondant à votre jugement de la sincérité du sourire.

Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à débuter l'expérimentation.

PART 2-A

For this part, you need to pay attention to the beginning of the smile, which means from the moment where the facial expression is neutral to when it is most intense.

To answer, you simply need to click at the appropriate location on the scale below.

Press on the 'y' key once you are ready to continue the experimentation.

PARTIE 2-B

Lors de cette partie, nous aimerions que vous prêtiez attention à la fin du sourire, soit entre le moment où le visage est le plus intense et le moment où le visage est neutre.

Pour répondre, vous cliquez simplement à l'endroit correspondant à votre jugement de la sincérité du sourire.

Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à poursuivre l'expérimentation.

PART 2-B

For this part, you need to pay attention to the end of the smile, which means from the moment where the facial expression is most intense to when it is neutral.

To answer, you simply need to click at the appropriate location on the scale below.

Press on the 'y' key once you are ready to continue the experimentation.

PARTIE 2-C

Lors de cette partie, nous aimerions que vous prêtiez attention à toute la durée du sourire.

Pour répondre, vous cliquez simplement à l'endroit correspondant à votre jugement de la sincérité du sourire.

Appuyez sur la touche "y" lorsque vous êtes prêt(e)s à poursuivre l'expérimentation.

PART 2-C

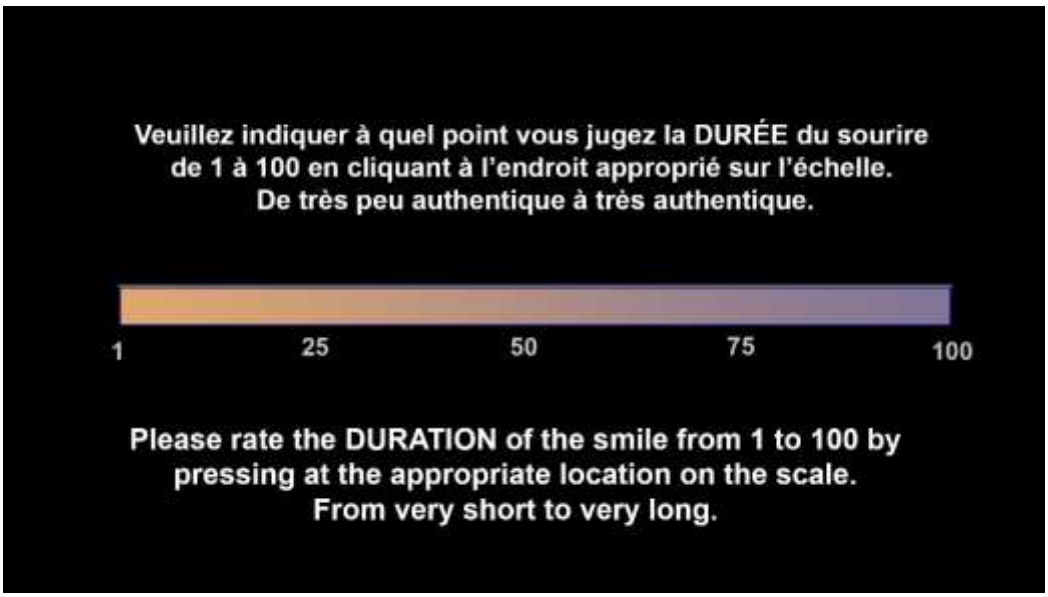
For this part, you need to pay attention to the whole smile.

To answer, you simply need to click at the appropriate location on the scale below.

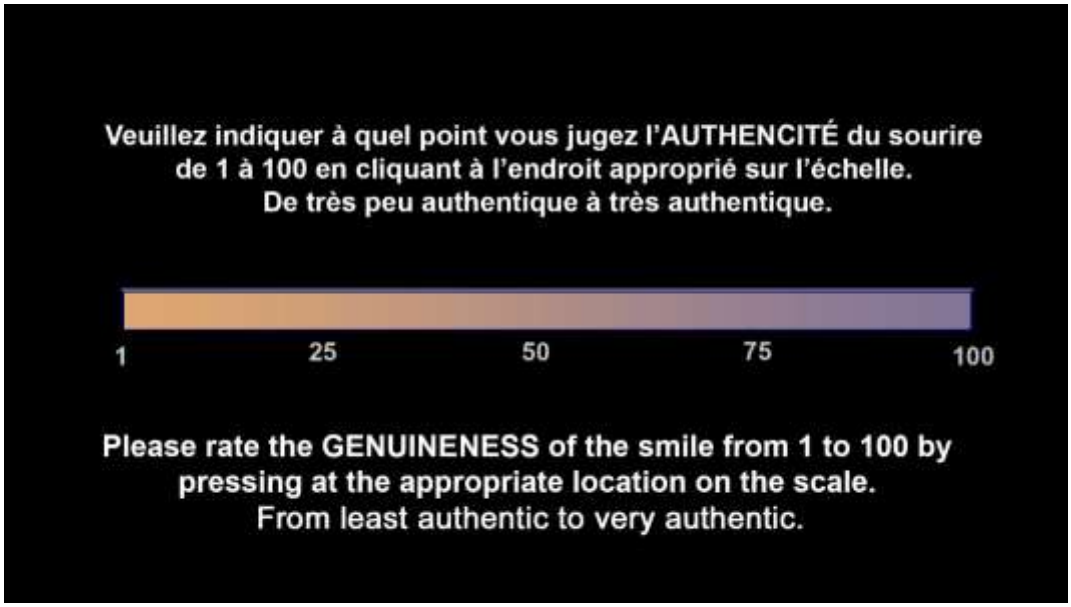
Press on the 'y' key once you are ready to continue the experimentation.

Choix de réponse

Partie 1



Partie 2



Annexe G

SUJET	MODIF	TYPE	DURÉE ONSET	APEX	DURÉE OFFSET	DURÉE TOTALE
1	**OFF**	20	1,001	1,5	0,2	2,701
		40	1,001	1,5	0,401	2,902
		60	1,001	1,5	0,602	3,103
		80	1,001	1,5	0,802	3,303
	ON	20	0,2	1,5	1,001	2,701
		40	0,401	1,5	1,001	2,902
		60	0,602	1,5	1,001	3,103
		80	0,802	1,5	1,001	3,303
	SYM	100	1,001	1,5	1,001	3,503
		20	0,2	1,5	0,2	1,902
		40	0,401	1,5	0,401	2,3025
		60	0,602	1,5	0,602	2,703
		80	0,802	1,5	0,802	3,1035
	APEX	1,0	1,001	1,0	1,001	3,004

Table 6. 1. Durations of the various phases for the model 1 stimuli

SUJET	MODIF	TYPE	DURÉE ONSET	APEX	DURÉE OFFSET	DURÉE TOTALE
2	**OFF**	20	1,0	1,5	0,202	2,702
		40	1,0	1,5	0,403	2,903
		60	1,0	1,5	0,603	3,103
		80	1,0	1,5	0,803	3,303
	ON	20	0,202	1,5	1,0005	2,702
		40	0,403	1,5	1,0005	2,903
		60	0,603	1,5	1,0005	3,103
		80	0,803	1,5	1,0005	3,303
	SYM	100	1,0	1,5	1,0005	3,502
		20	0,202	1,5	0,202	1,902
		40	0,403	1,5	0,403	2,302
		60	0,603	1,5	0,603	2,7025
		80	0,803	1,5	0,803	3,103
	APEX	1,0	1,0	1,0	1,0005	3,003

Table 6. 2. Durations of the various phases for the model 2 stimuli

SUJET	MODIF	TYPE	DURÉE ONSET	APEX	DURÉE OFFSET	DURÉE TOTALE
3	**OFF**	20	1,0	1,5	0,202	2,702
		40	1,0	1,5	0,402	2,902
		60	1,0	1,5	0,603	3,103
		80	1,0	1,5	0,801	3,301
	ON	20	0,202	1,5	1,0	2,702
		40	0,402	1,5	1,0	2,902
		60	0,603	1,5	1,0	3,103
		80	0,801	1,5	1,0	3,301
	SYM	100	1,0	1,5	1,0	3,502
		20	0,202	1,5	0,202	1,902
		40	0,402	1,5	0,402	2,302
		60	0,603	1,5	0,603	2,703
		80	0,801	1,5	0,801	3,1035
	APEX	1,0	1,0	1,0	1,0	3,003

Table 6. 3. Durations of the various phases for the model 3 stimuli