**UNIVERSITE DE BOURGOGNE-FRANCHE-COMTE**

**Centre des Sciences du Goût et de l'Alimentation**

Ecole doctorale Environnements – Santé


# THESE DE DOCTORAT

**Discipline : Biologie des organismes**

# Privilégier la santé ou le plaisir : Impact des attitudes envers l'alimentation et du contexte sur les choix alimentaires des enfants normo-pondéraux et en surpoids âgés de 5 à 11 ans


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# Résumé

Plaisir et santé sont deux concepts souvent opposés lorsqu'il est question d'alimentation. Néanmoins, les conséquences sur les choix alimentaires de privilégier la santé ou le plaisir ne sont pas clairement établies, en particulier chez l'enfant. Pourtant, mieux appréhender chez l'enfant les déterminants des choix alimentaires favorables à la santé, ou au contraire délétères, semble primordial étant donné que les habitudes alimentaires sont formées précocement. Il apparaît donc nécessaire d'étudier comment les enfants s'approprient les considérations liées au plaisir et à la santé et dans quelle mesure celles-ci influencent leurs choix alimentaires. Pour répondre à ces questions, nous avons étudié à la fois l'influence des attitudes et du contexte sur les choix alimentaires des enfants normo-pondéraux et en surpoids. Nous avons mis en évidence que la dominance relative des bases hédoniques et nutritionnelles des attitudes implicites et/ou explicites des enfants envers l'alimentation variaient en fonction de leur niveau scolaire, de leur statut pondéral et de leur milieu culturel. De plus, les enfants dont les attitudes implicites et explicites étaient les plus basées sur des considérations liées à la santé étaient ceux qui effectuaient les choix de moins bonne qualité nutritionnelle lors d'un goûter proposé au laboratoire. Néanmoins, dans certains contextes, nous avons montré que valoriser la santé pouvait conduire à des choix de meilleure qualité nutritionnelle par les enfants. Ces résultats nous ont permis d'amorcer une réflexion quant à la place que pourrait jouer le plaisir dans la promotion de comportements alimentaires favorables à la santé chez les enfants normo-pondéraux ou en surpoids.

**Mots-clés :** plaisir ; santé ; attitude ; contexte ; choix alimentaire ; enfant ; statut pondéral

# Abstract

In the food domain, pleasure and health are often viewed as two opposite sides of a coin. However, surprisingly sparse research has examined the relative influence of hedonic versus nutritional considerations on food choices, especially in children. Yet, a better understanding of the factors that underlie healthy or unhealthy eating in children is of particular importance because eating habits are early shaped. To fill this gap, we explored the relationships between hedonic- versus nutrition-based attitudes towards food, pleasure- versus health-oriented eating contexts and children's food choices. First, our results showed that the relative dominance of nutrition- versus hedonic-based implicit and/or explicit attitudes varied by school level, weight status and cultural context in children. Moreover, children with implicit and explicit nutrition-based attitudes performed the unhealthiest food choices for their afternoon snack during a buffet test in our laboratory. However, a health-oriented context has been shown to enhance healthy food choices compared to a pleasure-oriented context. Collectively, these results add to the literature regarding the determinants of children's eating behaviors and give some interesting insights regarding the potential role of pleasure in building public health strategies to promote healthy eating behaviors among normal- and overweight children.

**Keywords:** pleasure; healthiness; attitude; context; food choice; children; weight status

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# Liste des abréviations

IAT : *Implicit Association Task*, en français Test d'Association Implicite

IMC : Indice de Masse Corporelle

IOTF : International Obesity Task Force

MIAM (outil) : Mesure via Internet du plaisir AliMentaire chez l'enfant

OMS : Organisation Mondiale de la Santé

# Publications présentées

### Article 1 :

Monnery-Patris, S., **Marty, L**., Bayer, F., Nicklaus, S., & Chambaron, S. (2016). Explicit and implicit tasks for assessing hedonic- versus nutrition-based attitudes towards food in French children. *Appetite*, 96(2016), 580–587. http://doi.org/10.1016/j.appet.2015.10.026

### Article 2 :

**Marty, L**., Chambaron, S., Bournez, M., Nicklaus, S., & Monnery-Patris, S. (2017). Comparison of implicit and explicit attitudes towards food between normal- and overweight French children. *Food Quality and Preference*, 60, 145–153. http://doi.org/10.1016/j.foodqual.2017.04.013

### Article 3 :

**Marty L**., Monnery-Patris S., Chambaron S., Nicklaus S., Forestell C. A. Implicit and explicit attitudes toward food in American and French children: A cross-cultural study. *Soumis à Appetite*

### Article 4 :

**Marty L.**, Miguet M., Bournez M., Nicklaus S., Chambaron S., Monnery-Patris S. Do hedonic- versus nutrition-based attitudes toward food predict food choices? A cross-sectional study of 6- to 11-year-olds (2017). *International Journal of Behavioral Nutrition and Physical Activity*, (2017) 14:162. https://doi.org/10.1186/s12966-017-0618-4

### Article 5:

**Marty L.**, Nicklaus S., Miguet M., Bournez M., Chambaron S., Monnery-Patris S. When do healthiness and liking drive children's food choices? The influence of social context and weight status. *En révision pour Appetite*

### Article 6 :

**Marty L**, Bentivegna H, Nicklaus S, Monnery-patris S, Chambaron S. Non-Conscious Effect of Food Odors on Children's Food Choices Varies by Weight Status (2017). *Front. Nutr*. 2017;4. http://doi.org/10.3389/fnut.2017.00016

### Article 7:

**Marty, L.**, Chambaron, S., Nicklaus, S., & Monnery-Patris, S. (2018). Learned pleasure from eating: an opportunity to promote healthy eating in children? *Appetite*, 120, 265–274. http://dx.doi.org/10.1016/j.appet.2017.09.006

# Autres communications scientifiques

## Autres publications issues de ce travail de thèse

**Marty L**, Chambaron S, Bournez M, Nicklaus S, Monnery-Patris S, External, emotional and restrained eating in normal- and overweight French children: do parents and children agree? *En préparation pour Appetite*

Juneau C, **Marty L**, Duquennoy A, Chabanet C, Nicklaus S, Chambaron S, Impact of non-attentively perceived food odors on attentional bias towards "food pleasure" and "weight control" concepts in normal- and overweight children. *En préparation*

## Communications orales

**Marty L**, Bentivegna H, Nicklaus S, Monnery-Patris S, Chambaron S, Non-Conscious Effect of Food Odors on Children's Food Choices Varies by Weight Status, *Congrès "Society for the Study of Ingestive Behavior",* Montréal, Juillet 2017

**Marty L,** Pleasure or Health: Do children have to choose? *Séminaire PSYFOOD*, Bruxelles, Mai 2017

**Marty L**, Chambaron S, Bournez M, Nicklaus S, Monnery-Patris S, Attitudes vis-à-vis de l'alimentation chez l'enfant normo-pondéral et en surpoids, *Forum des Jeunes Chercheurs de l'Université de Bourgogne-Franche-Comté*, Besançon, Juin 2016

**Marty L**, Chambaron S, Bournez M, Nicklaus S, Monnery-Patris S, Implicit and explicit attitudes towards food in normal- and overweight French children, *Congrès "British Feeding and Drinking Group"*, Londres, Avril 2016

## Communications affichées

**Marty L**, Monnery-Patris S, Chambaron S, Nicklaus S, Forestell C A. Implicit and explicit attitudes towards food in American and French children: A cross-cultural study, *Congrès "Society for the Study of Ingestive Behavior",* Montréal, Juillet 2017

**Marty L**, Miguet M, Nicklaus S, Chambaron S, Monnery-Patris S. When do health and taste drive children's food choices? The influence of context and weight status, *Congrès "Society for the Study of Ingestive Behavior",* Montréal, Juillet 2017

**Marty L**, Bentivegna H, Nicklaus S, Monnery-Patris S, Chambaron S, Effects of olfactory priming on food choices in children: development of a new paradigm suitable for 6 to 11 year-olds, *Reward Symposium*, Bruxelles, Octobre 2016

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**Marty L**, Chambaron S, Bournez M, Nicklaus S, Monnery-Patris S, Attitudes des enfants en surpoids vis-à-vis de l'alimentation, *Congrès de la Société Française de Pédiatrie*, Lille, Mai 2016

**Marty L**, Chambaron S, Bournez M, Nicklaus S, Monnery-Patris S, Les enfants en surpoids seraient-ils moins hédonistes que les enfants normo-pondéraux ? *Journées Francophones de Nutrition,* Marseille, Décembre 2015 – Session des meilleurs posters

# PRÉAMBULE

En Europe occidentale, les enfants grandissent dans un contexte d'offre alimentaire pléthorique. Les enfants manifestent un attrait inné pour les aliments gras et sucrés (Nicklaus, Boggio, & Issanchou, 2005), que la publicité tend à rendre encore plus attractifs en valorisant le plaisir de leur consommation (Strasburger, 2006). Ce contexte, considéré comme partiellement responsable de l'épidémie actuelle d'obésité, est parfois qualifié d'obésogène (Swinburn, Egger, & Raza, 1999). Afin de lutter contre l'épidémie d'obésité, de nombreuses interventions ont vu le jour pour inciter les enfants à consommer plus d'aliments « bons » pour la santé, notamment plus de fruits et de légumes (Knai, Pomerleau, Lock, & McKee, 2006). Ces interventions sont souvent basées sur une information nutritionnelle : on apprend aux enfants quels sont les aliments « bons » ou « mauvais » pour la santé. Les campagnes nationales (ex. : le Programme National Nutrition Santé en France) prodiguent aussi ce type d'information dans le but d'orienter les comportements alimentaires vers des pratiques qui préservent la santé des individus (« Pour votre santé évitez de manger trop gras, trop salé, trop sucré. » ; « Pour votre santé mangez au moins cinq fruits et légumes par jour. »).

Les enfants déclarent prendre en compte à la fois le critère « plaisir » et le critère « santé » lors de leurs choix alimentaires (Fitzgerald, Heary, Nixon, & Kelly, 2010; McKinley et al., 2005). Néanmoins, l'influence de la prise en compte respective de ces deux critères sur la qualité nutritionnelle des choix alimentaires des enfants n'est pas claire. D'une part, il a été montré que les enfants associent majoritairement le plaisir aux aliments « mauvais » pour la santé, riche en gras, en sucres et en sel, tandis que les aliments « bons » pour la santé, comme les fruits et légumes, sont les moins appréciés (Cooke & Wardle, 2005; Nicklaus, Boggio, & Issanchou, 2005; Russell & Worsley, 2007). D'autre part, des études interculturelles chez l'adulte suggèrent que le plaisir alimentaire pourrait être associé à une alimentation plus équilibrée avec des effets bénéfiques sur la santé (Rozin, Fishler, Imada, Sarubin, & Wrzesniewski, 1999; Saulais, Doyon, Ruffieux, & Kaiser, 2012). D'un côté, les interventions visant à améliorer la qualité de l'alimentation des enfants leur inculquent des connaissances nutritionnelles (Wolfenden et al., 2012). D'un autre côté, il a été montré que désigner les aliments comme « bons pour la santé » pouvait amener les enfants à moins les apprécier et à moins les consommer (Maimaran & Fishbach, 2014; Wardle & Huon, 2000). Afin de mieux appréhender les déterminants des choix alimentaires favorables à la santé, ou au contraire délétères, il apparaît donc nécessaire d'étudier comment les enfants s'approprient les

considérations liées au plaisir et à la santé et dans quelle mesure celles-ci influencent leurs choix alimentaires. Cela pourrait contribuer à élaborer des stratégies de communication et d'intervention efficaces afin de promouvoir une alimentation équilibrée dès l'enfance. En effet, les habitudes alimentaires restant en grande partie stables au cours de la vie (Nicklaus, Boggio, Chabanet, & Issanchou, 2004, 2005; Nicklaus & Remy, 2013), acquérir des habitudes alimentaires favorables à la santé dès l'enfance est crucial car elles seront les garantes d'une meilleure santé à l'âge adulte.

Cette thèse présente l'étude de l'influence des considérations liées au plaisir ou à la santé sur les choix alimentaires chez les enfants normo-pondéraux et en surpoids. Pour cela, nous étudions à la fois l'influence des attitudes et du contexte sur les choix alimentaires de l'enfant. De plus, ces questions sont déclinées chez les enfants normo-pondéraux et en surpoids car il a été montré que le statut pondéral des enfants pouvait être associé à des comportements alimentaires différents (Carnell & Wardle, 2008). Les modèles de prédiction des choix alimentaires incluent généralement des facteurs liés à l'aliment lui-même (e.g., les propriétés sensorielles), mais aussi des facteurs liés à l'individu (e.g., les attitudes) et à l'environnement (e.g., le contexte de consommation) (Steenkamp, 1993). Les attitudes sont décrites comme le rapport qu'un individu entretient avec un objet (Eagly & Chaiken, 1998). Elles combinent une composante cognitive et une composante affective (Millar & Tesser, 1986). Dans le domaine alimentaire, la composante cognitive des attitudes reflète entre autres les considérations en termes de qualité nutritionnelle et de conséquences sur la santé des aliments, tandis que la composante affective traduit notamment le plaisir ressenti au cours de l'acte alimentaire (Dubé & Cantin, 2000). Quant au contexte de consommation, il est susceptible de mobiliser, via des facteurs sociaux ou physiques, des considérations plutôt liées au plaisir ou à la santé (Connors, Bisogni, Sobal, & Devine, 2001).

Cette thèse s'articule autour de quatre grands axes comprenant (1) le développement d'un outil permettant de caractériser, chez l'enfant, l'importance relative du plaisir et de la santé envers l'alimentation, que nous nommerons profil attitudinal santé/plaisir, (2) l'identification des déterminants du profil attitudinal santé/plaisir chez l'enfant, (3) l'étude de l'influence du profil attitudinal santé/plaisir sur les choix alimentaires des enfants, et (4) l'étude de l'influence du contexte santé/plaisir sur les choix alimentaires des enfants.

Ce travail de thèse s'inscrit dans le cadre du projet PUNCH (Promoting and Understanding healthy food choices in CHildren). PUNCH est un projet de recherche collaboratif porté par Sophie Nicklaus d'une durée de 4 ans (2016-2020) ayant reçu un

financement de l'Agence Nationale de la Recherche. Le but premier de ce projet est de proposer de nouvelles stratégies permettant de favoriser les comportements alimentaires bons pour la santé chez les enfants (de 3 mois à 11 ans) au-delà des approches traditionnelles basées sur la dissémination d'une information cognitive des bénéfices/risques de l'alimentation sur la santé. Plus précisément, PUNCH se donne pour objectifs (1) de mieux comprendre les déterminants du comportement alimentaire des bébés et des enfants en prenant en compte à la fois les aspects sociologiques, psychologiques et sensoriels de l'acte alimentaire, et (2) d'évaluer l'efficacité de leviers innovants pour modifier favorablement les comportement alimentaires des enfants d'âge scolaire ; ces nouveaux leviers s'inspirent à la fois de la psychologie cognitive, des sciences du comportement, de l'économie et du marketing. Les travaux de cette thèse contribuent à ces deux axes de recherches.

# CHAPITRE 1 : INTRODUCTION

L'introduction de ce travail s'articule autour de cinq parties décrivant les enjeux scientifiques et méthodologiques de la thèse. La première partie décrit le contexte sociétal en rapport avec l'alimentation des enfants dans lequel s'inscrit cette thèse. Ensuite nous présenterons les mécanismes des choix alimentaires, puis nous explorerons les liens entre attitudes et choix alimentaires, et contexte et choix alimentaires chez l'enfant. Enfin, nous présenterons les ambitions de ce travail de thèse et décrirons les méthodologies employées.

# 1. Contexte sociétal : obésité infantile et valeurs « plaisir » et « santé » attachées à l'alimentation de l'enfant

Le contexte alimentaire pléthorique des sociétés occidentales a conduit certains auteurs à le qualifier d'obésogène (Swinburn et al., 1999). D'ailleurs, l'OMS reconnaît que la prévalence croissante de l'obésité de l'enfant est notamment le résultat de changements survenus dans la société (OMS, 2017). L'enfant, en tant qu'omnivore, doit apprendre ce qu'il est bon pour lui de manger (Rozin, 1990). Pour cela, il a hérité d'un bagage évolutif lui permettant de ressentir du plaisir lors de la consommation d'aliments qui vont garantir sa survie, notamment les aliments denses énergétiquement (Nicklaus, Boggio, & Issanchou, 2005). Aujourd'hui, ces aliments sont facilement disponibles et cela peut conduire à leur surconsommation, délétère pour la santé des enfants. L'étude de l'influence des valeurs de « plaisir » et de « santé » sur les choix alimentaires des enfants normo-pondéraux et en surpoids est donc particulièrement pertinente dans ce contexte inédit d'offre alimentaire surabondante et de forte prévalence de l'obésité infantile.

## 1.1. L'obésité chez l'enfant

### *1.1.1. Les faits et les chiffres dans le monde et en France*

L'OMS définit le surpoids et l'obésité comme une accumulation anormale ou excessive de graisse pouvant nuire à la santé (OMS, 2015). En effet, à l'âge adulte, le surpoids et l'obésité sont associés à un risque plus élevé d'apparition de diabète de type II, d'hypertension, de maladies cardiovasculaires, de cancers, de troubles musculo-squelettiques (OMS, 2015). Or, être un enfant en surpoids ou obèse augmente considérablement le risque de devenir un adulte lui-même en surpoids ou obèse (Singh, Mulder, Twisk, Van Mechelen, &

Chinapaw, 2008). Mais déjà chez l'enfant, le surpoids et l'obésité ont des conséquences en termes de santé : troubles respiratoires, risque accru de fractures, hypertension artérielle, résistance à l'insuline, problèmes psychologiques (OMS, 2014).

Chez l'adulte, le surpoids et l'obésité sont le plus souvent évalués via le calcul de l'indice de masse corporelle (IMC = poids/taille² (kg/m²)). Selon la classification de l'OMS, le surpoids est défini par un IMC supérieur à 25 kg/m² et l'obésité par un IMC supérieur à 30 kg/m². En 2014 dans le monde, 39% des adultes de plus de 20 ans étaient en surpoids, 13% étaient obèses, et le nombre de cas d'obésité (600 millions) avait doublé depuis 1980 (OMS, 2015). En France, une étude de 2016 a estimé que 41,0% des hommes et 25,3% des femmes de 30 à 69 ans étaient en surpoids, tandis que 15,8% des hommes et 15,6 des femmes étaient obèses (Matta et al., 2016).

Chez l'enfant (de 0 à 18 ans), l'IMC est un indicateur du statut pondéral pour un âge et un sexe donné. Afin d'évaluer le surpoids et l'obésité chez l'enfant, des courbes de références de l'IMC en fonction de l'âge et du sexe de l'enfant et attachées à une population sont utilisées. Ces courbes permettent de calculer la déviation standard de l'IMC par rapport à la moyenne d'une population à chaque âge, pour les garçons et pour les filles. On parle de z-score de l'IMC. Les courbes de références utilisées peuvent être nationales ou internationales. Du fait de la variabilité de morphologie, de croissance et de corpulence selon les populations, les courbes de références propres à chaque pays, couramment utilisées dans les études nationales, ne sont pas identiques. A titre d'exemple, le 97$^{ème}$ percentile de la distribution des valeurs de référence de l'IMC en France correspond au 85$^{ème}$ percentile des valeurs de références américaines (Charles, 2007). Néanmoins, la comparaison des données entre différents pays nécessite l'utilisation de références internationales (Cole, Bellizzi, Flegal, & Dietz, 2000). Les seuils internationaux de surpoids et d'obésité chez les enfants ont été établis par l'International Obesity Task Force (anciennement IOTF, World Obesity Clinical Care aujourd'hui) : ce sont les courbes de percentiles atteignant respectivement 25 (IOTF 25) et 30 kg/m² (IOTF 30) à 18 ans. En France, les courbes de Rolland-Cachera et al. (1991) font office de références nationales, et les seuils sont définis comme suit (**Figure 1**) :

- insuffisance pondérale : IMC inférieur au 3$^{ème}$ percentile (z-score de l'IMC < -2)
- corpulence normale : IMC entre les 3$^{ème}$ et 97$^{ème}$ percentiles (-2 ≤ z-score de l'IMC ≤ 2)
- surpoids et obésité : IMC supérieur au 97$^{ème}$ percentile (z-score de l'IMC > 2)

- obésité : IMC supérieur au seuil international IOTF 30 (z-score de l'IMC > 3)

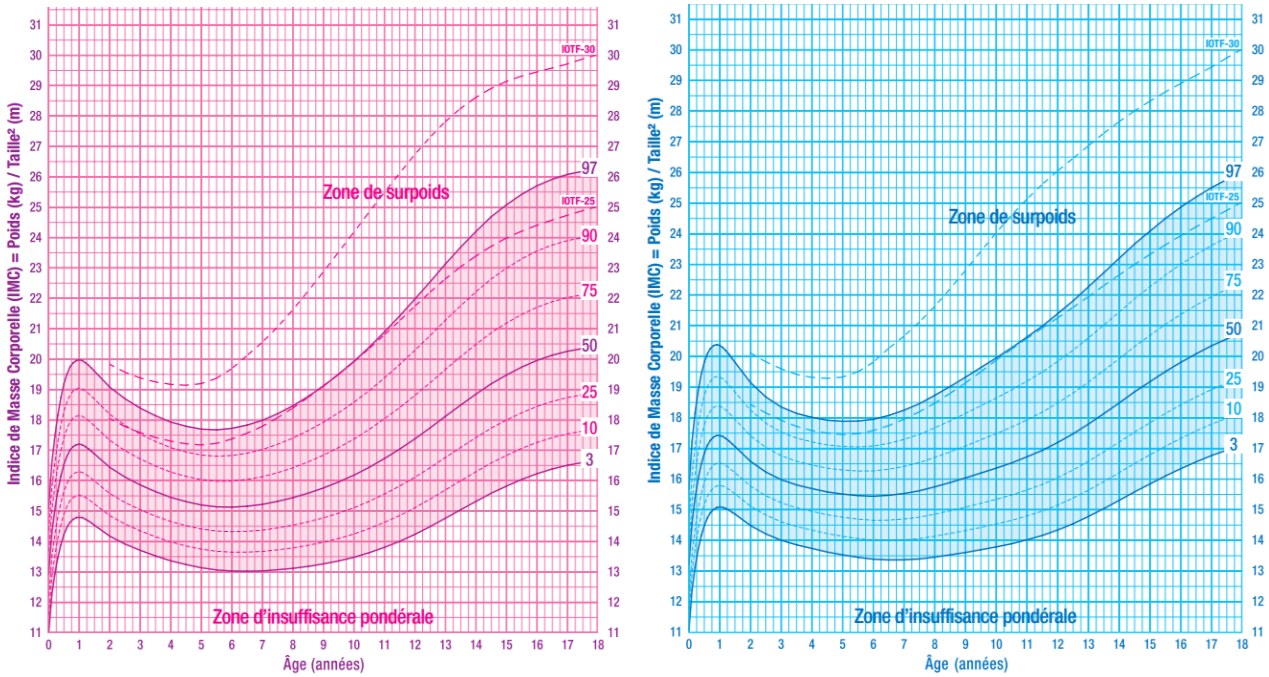


**Figure 1.** Courbes de l'IMC en fonction de l'âge pour les filles et les garçons français

A l'échelle mondiale, le nombre de jeunes enfants (moins de 5 ans) en surpoids ou obèses a drastiquement augmenté lors des dernières décennies, passant de 32 millions en 1990 à 42 millions en 2013 (OMS, 2014). En 2004 dans le monde, 10% des enfants de 5 à 17 ans étaient estimés en surpoids et 2 à 3% obèses (Lobstein, Baur, & Uauy, 2004). En France, en 2015, 17% des enfants âgés de 6 à 17 ans sont en surpoids ou obèses, dont 3,9% classés comme obèses (Verdot, Torres, Salanave, & Deschamps, 2017). Une stabilisation de cette prévalence a été observée chez les enfants de 6 à 17 ans entre 2006 et 2015 (Verdot et al., 2017).

La forte prévalence du surpoids et de l'obésité en France et dans le monde ainsi que leurs conséquences néfastes sur la santé, aussi bien durant l'enfance qu'à l'âge adulte, en font des fléaux majeurs de nos sociétés contemporaines. Aussi, la compréhension de l'apparition du surpoids et de l'obésité, ainsi que les moyens de les prévenir, constituent des enjeux majeurs de la recherche scientifique concernant la nutrition et les comportements alimentaires.

### *1.1.2. L'obésité infantile : une étiologie multifactorielle*

S'il est admis que la prise de poids résulte d'un déséquilibre positif chronique entre apports et dépenses énergétiques, les mécanismes conduisant à ce déséquilibre sont

complexes et toujours mal connus et mal compris. On admet qu'il existe dans l'étiologie de l'obésité trois composantes : génétique, environnementale et psychologique (Sahoo et al., 2015). De plus, ces composantes interagissent entre elles. Par exemple, l'environnement peut agir directement sur l'expression des gènes en induisant des modifications épigénétiques *in utero* (e.g., méthylation de l'ADN, modification des histones) (Albuquerque, Stice, Rodríguez-López, Manco, & Nóbrega, 2015).

La composante génétique a été décrite comme la cause principale de l'obésité infantile suite à de nombreuses études impliquant des jumeaux ou des sujets adoptés (pour une revue systématique de la litérature, voir Silventoinen, Rokholm, Kaprio, & Sorensen, 2010). Néanmoins, seul un environnement obésogène (i.e., abondance de la nourriture, réduction de l'activité physique, sédentarisation des jeux et loisirs) peut permettre l'expression phénotypique d'une prédisposition génétique à l'obésité. L'OMS reconnaît d'ailleurs que la prévalence croissante de l'obésité de l'enfant est le résultat de changements survenus dans la société (OMS, 2017) :

- « un changement de régime alimentaire observé sur le plan mondial qui se traduit par une consommation accrue d'aliments très énergétiques à haute teneur en graisses et en sucres mais contenant trop peu de vitamines, de minéraux et d'autres micronutriments »
- « une tendance à la diminution de l'activité physique en raison de la nature sédentaire de nombreuses formes de loisirs, du changement de modes de transport et de l'urbanisation galopante »

Au niveau individuel, il a été mis en évidence que certains traits tempéramentaux en lien avec l'alimentation étaient associés à l'obésité et/ou au risque d'obésité chez l'enfant (Carnell & Wardle, 2008). Par exemple, plusieurs études utilisant différentes méthodologies, ont mis en évidence que les enfants en surpoids étaient plus perméables à l'environnement alimentaire : ils consomment plus des aliments palatables (i.e., des aliments plutôt gras, sucrés, salés et très appréciés) mis à leur dispositions alors même qu'ils n'ont plus faim (Hill et al., 2008; Shomaker et al., 2010), ils consomment plus d'aliments palatables après les avoir sentis (Jansen et al., 2003), ils sont plus attentifs à des mots faisant référence à des aliments (Braet & Crombez, 2003a) et plus attirés par des images et des odeurs d'aliments (Nederkoorn, Coelho, Guerrieri, Houben, & Jansen, 2012; Soussignan, Schaal, Boulanger, Gaillet, & Jiang, 2012). Il a aussi été montré que les enfants de 7 à 10 ans prêts à fournir le

plus d'effort pour obtenir un aliment palatable, étaient les plus susceptibles d'avoir pris du poids un an plus tard (Hill, Saxton, Webber, Blundell, & Wardle, 2009). De plus, les enfants de 4 ans qui ne parviennent pas à « retarder leur plaisir » (i.e., qui choisissent de manger un chamallow maintenant plutôt que deux 15 minutes plus tard) ont plus de risque d'être en surpoids à l'âge de 11 ans (Seeyave et al., 2009) et ont un IMC supérieur 30 ans plus tard (Schlam, Wilson, Shoda, Mischel, & Ayduk, 2013).

D'après ces différentes études, il semble donc que la conjonction d'un environnement offrant des aliments hautement palatables, et d'une sensibilité individuelle aux signaux externes émanant de ces aliments, soit un facteur de risque de l'apparition d'un surpoids ou d'une obésité chez l'enfant. Or, une fois que le surpoids ou l'obésité sont établis chez un enfant, il est très difficile de lui faire retrouver un poids normal au travers d'interventions (Luttikhuis et al., 2009). C'est pourquoi la prévention primaire (i.e., en population générale) apparaît comme un enjeu de santé publique extrêmement important. Dans le contexte actuel d'une offre alimentaire pléthorique, les gouvernements des pays occidentaux mettent en place des politiques publiques de prévention de l'obésité qui passent notamment par la promotion d'une alimentation de bonne qualité nutritionnelle.

## 1.2. Le plaisir et la santé dans l'alimentation de l'enfant

### *1.2.1. Le plaisir alimentaire : une menace pour la santé de l'enfant ?*

Le plaisir alimentaire est une notion centrale lorsqu'on s'intéresse aux comportements alimentaires, il est parfois décrit comme le principal moteur de la prise alimentaire (Drewnowski, 1997; Yeomans, Blundell, & Leshem, 2004). Il existe d'ailleurs une littérature riche et pluridisciplinaire à ce sujet (Drouard et al., 2006), mais pas de consensus quant à sa définition. Lorsque nous parlerons de *plaisir alimentaire* dans ce manuscrit de thèse, nous désignerons la sensation plaisante qui peut accompagner la consommation d'un aliment (Frijda, 2009).

Dès la naissance, le plaisir est lié à la satisfaction des besoins physiologiques. Les enfants présentent un attrait inné pour la saveur sucrée, qui est un marqueur de la densité énergétique des aliments (Camille Schwartz, Issanchou, & Nicklaus, 2009; Steiner, 1979). Le plaisir alimentaire est donc avant tout un phénomène adaptatif qui guide le nouveau-né vers les aliments à même de garantir sa survie. Lorsque les enfants grandissent, le plaisir reste un

moteur important de leurs choix alimentaires : ils consomment les aliments qu'ils aiment et laissent les autres (Birch, 1999; Birch, 1979). Or, leurs préférences ne coïncident pas avec les recommandations nutritionnelles : ils apprécient généralement les aliments à haute densité énergétique, mais moins les fruits et les légumes (Cooke & Wardle, 2005; Adam Drewnowski, 2009; Gibson & Wardle, 2003; Nicklaus, Boggio, & Issanchou, 2005; Russell & Worsley, 2007). De plus, il a été mis en évidence que le plaisir procuré par la consommation d'aliments particulièrement palatables pouvait outrepasser les mécanismes de contrôle de la prise alimentaire (i.e., les mécanismes physiologiques qui garantissent le maintien du poids comme les signaux de faim et de satiété) (Dalton & Finlayson, 2013; Stroebe, Papies, & Aarts, 2008). Dans le contexte d'une offre abondante d'aliments palatables, ce phénomène peut conduire certains enfants à consommer au-delà de leur besoins (e.g., en l'absence de faim), et de ce fait provoquer un déséquilibre chronique de leur balance énergétique menant à l'apparition d'un surpoids (Booth, Pinkston, & Carlos Poston, 2005).

Le plaisir dérive donc précocement des aliments de densité énergétique élevée. Or, dans nos sociétés occidentales actuelles, de tels aliments sont considérés comme « mauvais » pour la santé car ils menacent l'équilibre nutritionnel et le maintien du poids, notamment des enfants. C'est pourquoi le plaisir alimentaire peut être vu comme une menace pour la santé. Dans cette perspective, il semble donc nécessaire d'intervenir pour inciter les enfants à consommer moins de ces aliments « mauvais », tels que les aliments riches en graisses, sel et sucre, et plus d'aliments « bons » pour la santé, tels que les fruits et les légumes.

### *1.2.2. L'information santé : une stratégie efficace pour promouvoir un régime alimentaire équilibré chez l'enfant ?*

Waters et al. (2011) ont effectué une revue systématique de la littérature incluant 55 études interventionnelles pour la prévention de l'obésité chez l'enfant. Leur travail suggère que les programmes prenant en compte une large variété de leviers au niveau de l'enfant lui-même (e.g., augmenter les connaissance nutritionnelles via des cours à l'école) et de son environnement (e.g., améliorer la qualité nutritionnelle de l'offre alimentaire de la cantine scolaire, impliquer les parents pour qu'ils encouragent les enfants à manger mieux) semblent efficaces pour prévenir l'apparition d'une obésité. Néanmoins, les auteurs soulignent la nécessité de transposer ces interventions au niveau de la population en impliquant notamment les acteurs des systèmes éducatif et médical.

Lancé en 2001 en France, le Programme National Nutrition Santé (PNNS) est un plan de santé publique qui vise à améliorer l'état de santé de la population en agissant sur l'équilibre entre les apports liés à l'alimentation et les dépenses occasionnées par l'activité physique (Hercberg, Chat-Yung, & Chauliac, 2008). Un exemple d'action a consisté en la diffusion dans les médias de messages à destination des enfants tels que « *Pour bien grandir, mange au moins cinq fruits et légumes par jour* » ou « *Pour bien grandir, ne mange pas trop gras, trop sucré, trop salé* ». Un autre exemple a consisté en la diffusion des neufs repères nutritionnels du PNNS sous forme ludique pour les enfants (e.g., affiche : la marelle des 9 repères). Ces messages manient des arguments rationnels en lien avec la santé. Ils ont pour but de rendre plus attractifs les aliments « bons » pour la santé, tels que les fruits et les légumes, et au contraire de rendre moins attractifs les aliments « mauvais » pour la santé, tels que les aliments riches en graisses, sel et sucre.

La diffusion à grande échelle de messages « santé » en lien avec l'alimentation amène les enfants à acquérir très tôt de bonnes connaissances quant à la valeur santé des aliments. Aux âges de 4 et 7 ans, ils sont capables de classer correctement les aliments dans les catégories « bons » ou « mauvais » pour la santé (Nguyen, 2008). Néanmoins, attacher une valeur santé à un aliment donné n'est pas en soi une garantie de choix alimentaires nutritionnellement adéquats. Deux études ont mis en évidence un effet contre-productif de l'information « santé » sur les comportements alimentaires des enfants (Maimaran & Fishbach, 2014; Wardle & Huon, 2000). Wardle & Huon (2000) ont présenté les deux mêmes boissons à des enfants de 9-11 ans. La première était présentée comme « une nouvelle boisson », la seconde comme « une nouvelle boisson bonne pour la santé ». Après avoir goûté les deux options, qui étaient en réalité identiques, les enfants ont déclaré préférer significativement la première, celle dépourvue de message santé. Maimaran & Fischbach (2014) ont proposé les mêmes biscuits à deux groupes d'enfants de 3-5 ans. Le premier groupe d'enfants s'est vu proposé les biscuits dans une condition neutre et le second groupe dans une condition « santé ». Un expérimentateur racontait une histoire aux enfants à propos d'une petite fille qui mangeait les biscuits avant qu'ils ne les consomment eux-mêmes. Dans la condition neutre, l'histoire se terminait par « Après avoir mangé les biscuits, elle est sortie dehors pour jouer », alors que dans la condition « santé » l'histoire se terminait par « Après avoir mangé les biscuits, elle se sent forte et en bonne santé ». Les enfants dans la condition « santé » ont moins consommé et moins apprécié les biscuits que les enfants dans la condition neutre.

Une information « santé » s'envisage dans un contexte global d'offre alimentaire qui valorise notamment le plaisir de manger des aliments gras, sucrés, salés via la publicité et le marketing destinés aux enfants (Strasburger, 2006). Une étude chez des enfants de 9-10 ans a mis en évidence que nombre d'entre eux pensaient : « si un aliment est bon au goût, alors il ne doit pas être bon pour ma santé ; si un aliment n'est pas bon au goût, alors il doit être bon pour ma santé » (Baranowski et al., 1993). Les deux études décrites au paragraphe précédent attestent que la réciproque est certainement vraie aussi : les enfants peuvent aussi penser que si un aliment est présenté comme bon pour la santé, alors il ne doit pas être bon au goût.

### *1.2.3. Plaisir et santé : deux concepts antinomiques lorsqu'il est question d'alimentation ?*

Les paragraphes précédents laissent supposer que plaisir et santé ne pourraient être envisagés qu'en opposition par les enfants : privilégier la santé se ferait au détriment du plaisir, et vice versa. Cependant, d'autres études ont montré que les relations entre les considérations liées au plaisir et à la santé, et les comportements alimentaires, sont plus complexes.

Engell et al. (1998) ont observé que donner une information sur le taux de matières grasses contenu dans des biscuits influençait différemment les préférences des enfants de 10 ans en fonction de leur niveau de préoccupation concernant les conséquences de l'alimentation sur leur santé. Les enfants les plus « préoccupés » déclaraient préférer les biscuits à faible teneur en matières grasses, alors que les enfants les moins « préoccupés » ne déclaraient pas de préférence en fonction du taux de matières grasses. De même, McFarlane & Pliner (1997) ont montré qu'une information nutritionnelle augmentait l'envie de goûter un nouvel aliment chez des enfants de 10 à 13 ans pour lesquels la nutrition est importante, mais au contraire la diminuait chez des enfants pour lesquels la nutrition n'est pas importante. Donc, chez certains enfants, les considérations nutritionnelles peuvent encourager des choix meilleurs pour la santé.

Chez l'adulte, deux études, l'une menée en France et l'autre aux Etats-Unis, ont mis en évidence que la relation entre la valeur santé et la valeur plaisir d'un aliment était différente d'un pays à l'autre. L'étude de Raghunathan et al. (2006), conduite avec des adultes américains, a mis en évidence que plus un aliment est décrit comme « mauvais » pour la santé, plus il est apprécié. A l'inverse, l'étude de Werle et al. (2013) a montré que des adultes

français appréciaient d'autant plus un aliment lorsqu'il était décrit comme « bon » pour la santé. Ces associations différentes entre plaisir et santé dans les deux pays peuvent s'expliquer par des différences culturelles quant au rapport à l'alimentation. La notion de « bien manger » aux Etats-Unis est associée à un bon équilibre en termes de nutriments et y parvenir requiert des connaissances nutritionnelles et un effort de la part des individus (Fischler & Masson, 2008). A l'inverse, en France, « bien manger » est associé au plaisir sensoriel et au plaisir du partage lors du repas (Fischler & Masson, 2008). L'acte alimentaire représente donc plutôt une source de préoccupation pour les adultes américains, et au contraire une source de bien-être pour les adultes français (Rozin et al., 1999; Rozin, 2005). Dans ce contexte, Werle et al. (2013) suggèrent que le fait que les Américains pensent leur alimentation en termes de « bon » ou « mauvais » pour la santé, d'aliments « interdits » ou « autorisés », ait pu renforcer l'attractivité des aliments « interdits ». Ceci aboutissant aux associations stéréotypiques suivantes : les aliments « mauvais » pour la santé sont meilleursau goût, et inversement les aliments « bons » pour la santé sont moins bons. Selon ces auteurs, considérer l'acte alimentaire comme un plaisir pourrait être le garant d'un régime alimentaire bon pour la santé (Fischler & Masson, 2008; Rozin et al., 1999; Werle et al., 2013).

Finalement, les conséquences sur les choix alimentaires de privilégier la santé ou le plaisir ne sont pas clairement établies. De plus, cette question n'a jamais été explorée chez l'enfant alors que l'identité du mangeur et ses habitudes alimentaires sont forgées durant les premières années de la vie (Forestell, 2017; Nicklaus, 2016; Nicklaus, Boggio, Chabanet, et al., 2005; Nicklaus & Remy, 2013). Par conséquent, mieux comprendre les mécanismes sous-jacents des choix alimentaires bons pour la santé, et ce dès l'enfance, apparaît donc comme un enjeu important.

## 2. Faire des choix alimentaires : l'influence du plaisir et de la santé

### 2.1. Les déterminants des comportements alimentaires

L'un des premiers modèles développé pour décrire les déterminants des comportements alimentaires est celui de Pilgrim (1957) qui identifie trois facteurs susceptibles d'influencer l'acceptation des aliments[1] : (1) l'état physiologique de l'individu

[1] Pilgrim discute de l'acceptation des aliments et non pas de leur choix ou de leur consommation ; néanmoins il considère la consommation comme la définition « opérationnelle » du concept d'acceptation des aliments.

(2) la perception des attributs sensoriels des aliments, et (3) l'environnement, qui par un effet d'apprentissage détermine les attitudes. Selon Pilgrim, l'acceptation d'un aliment, puis sa consommation, résulte donc de la perception de ses caractéristiques sensorielles en relation avec un environnement donné et un état physiologique particulier (**Figure 2**).

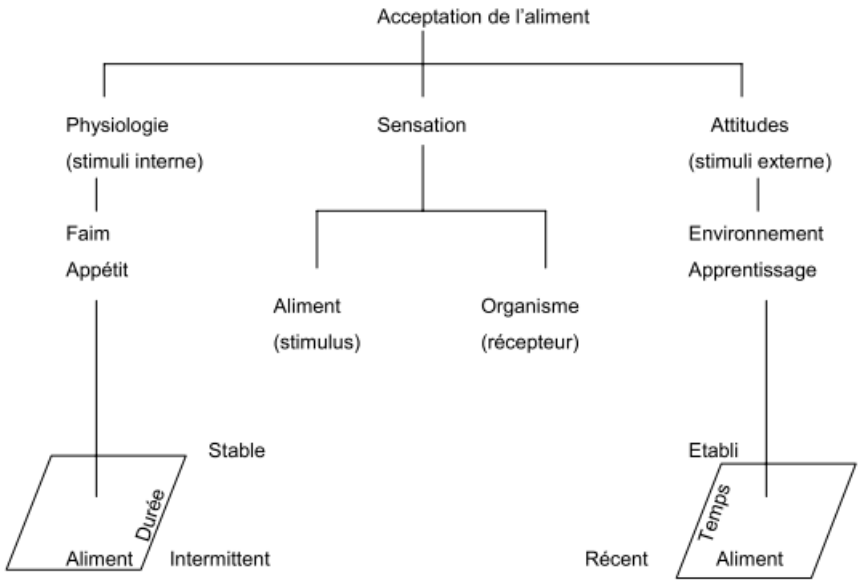


**Figure 2.** Modèle d'acceptation des aliments. (D'après Pilgrim, 1957)

Néanmoins, ce modèle historique occulte le rôle possible de variables psychologiques individuelles puisqu'il considère les attitudes comme le résultat exclusif d'un apprentissage lié aux expositions plus ou moins récentes à tel ou tel environnement alimentaire. Malgré ses limites, le modèle de Pilgrim a servi de point de départ à de nombreux modèles ultérieurs des déterminants des comportements alimentaires (Shepherd, 1990; Steenkamp, 1993). En dépit de quelques variations selon les modèles, on observe généralement la distinction entre trois types de déterminants des comportements alimentaires : (1) les propriétés des aliments, (2) les facteurs environnementaux, et (3) les facteurs individuels (**Figure 3**). Steenkamp (1993) insiste sur la nécessité d'appréhender de manière interdisciplinaire l'ensemble de ces types de déterminants et leurs interactions pour mieux comprendre les mécanismes de la prise de décision dans le domaine de l'alimentation.

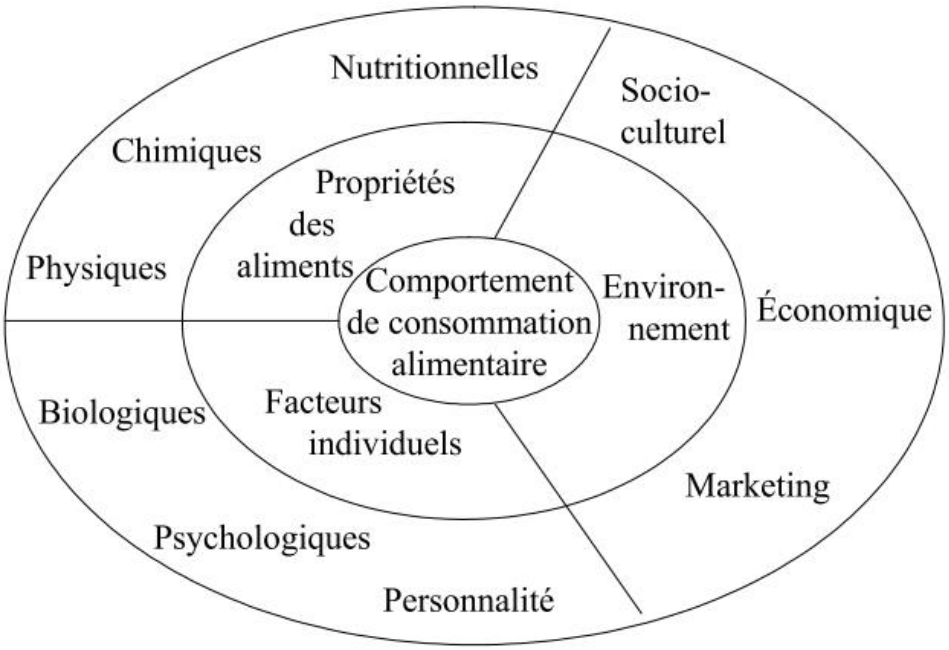


**Figure 3.** Les déterminants des comportements alimentaires. (D'après Steenkamp, 1993)

2.2. Le processus de prise de décision pour les choix alimentaires

En se basant sur le triptyque aliment-individu-environnement de nombreux auteurs ont proposé des modèles qui, plus que des catalogues de variables pouvant influencer les comportements alimentaires, apportaient des précisions sur les interactions entre les variables et les mécanismes qui mènent au choix d'un aliment en particulier (Shepherd, 1990; Sijtsema, Linnemann, Gaasbeek, & Dagevos, 2002). L'objectif de ce paragraphe n'est pas de proposer une revue exhaustive des modèles du comportement alimentaire, mais de présenter les études sur le processus de choix alimentaire qui constitueront le cadre théorique de ce travail de thèse.

La compréhension des mécanismes de la prise de décision a été abordée à la fois par des psychologues, des économistes et des philosophes, donnant lieu à une multitude de perspectives théoriques sur ce sujet (Hogarth & Reder, 1987; Kaplan, 1996; Kleindorfer, Kunreuther, & Shoemaker, 1993). Furst et al. (1996), et à leur suite Sobal et Bisogini (2009), se sont basés sur une approche constructionniste pour proposer un modèle du processus de choix alimentaire. Cette approche constructionniste considère que les choix des individus résultent d'une interaction entre cognition et environnement, notamment culturel (Archer, 1988). Le modèle qui en découle possède trois composantes majeures qui opèrent ensemble et mènent aux choix alimentaires : (1) les évènements et les expériences au cours de la vie, (2)

les influences, et (3) le système personnel de valeurs alimentaires. Le cours de la vie de chacun entraîne un éventail d'influences qui façonnent un ensemble personnel de valeurs et de stratégies concernant les choix alimentaires (**Figure 4**).

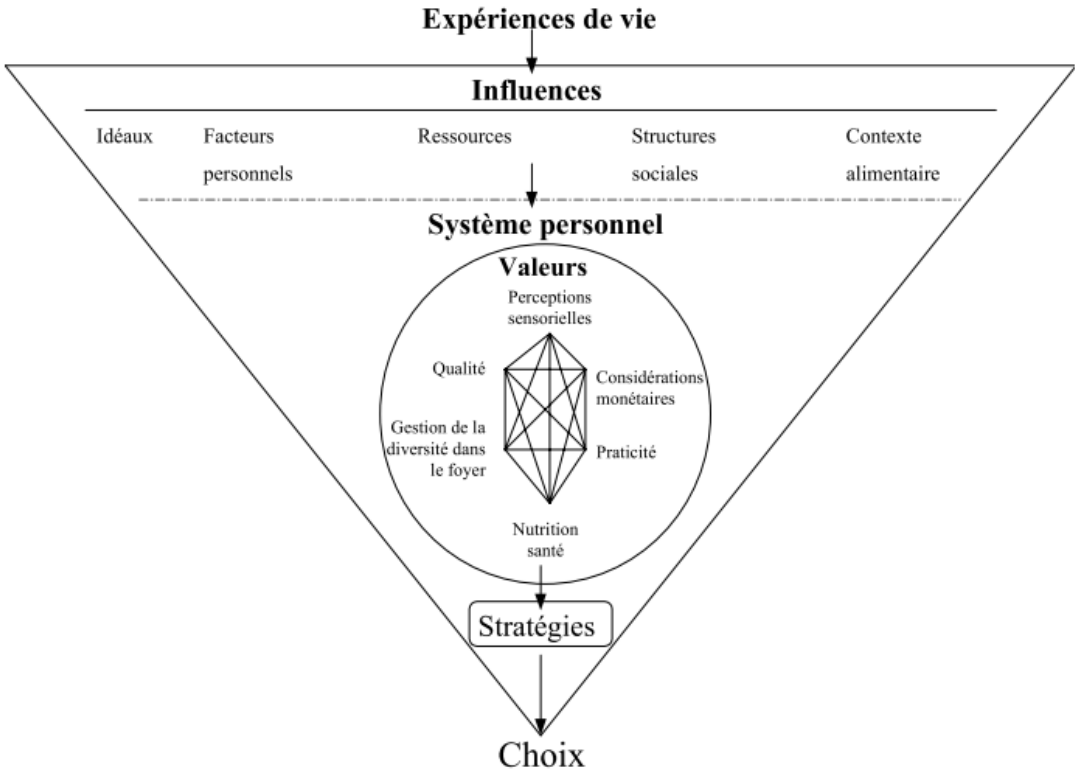


**Figure 4.** Modèle conceptuel du processus de choix alimentaire. (D'après Furst et al., 1996)

Le système personnel de valeurs alimentaires inclut les critères qui sont susceptibles d'être pris en compte lors d'un choix alimentaire. Différentes études conduites chez l'adulte ont mis en évidence six valeurs principales : les propriétés sensorielles des aliments, leur praticité, leur coût, la nutrition et la santé, et la gestion des préférences de chacun (au sein d'un foyer par exemple), et des valeurs secondaires, propres à certains groupes ou individus, comme l'éthique, la protection de l'environnement ou la religion. Les valeurs alimentaires sont propres à chacun et peuvent varier au cours de la vie, et en fonction de l'environnement socio-culturel.

Dans la lignée de ce modèle, Rangel (2013) a proposé une opérationnalisation du processus de choix alimentaire en quatre étapes : (1) l'identification des options disponibles, (2) l'évaluation et la comparaison des différentes options en faisant appel au système personnel de valeurs alimentaires, (3) l'évaluation des conséquences du choix *a posteriori*, et

(4) la mise à jour de la valeur de l'aliment choisi, basée sur l'expérience que l'on vient d'avoir avec cet aliment (**Figure 5**)

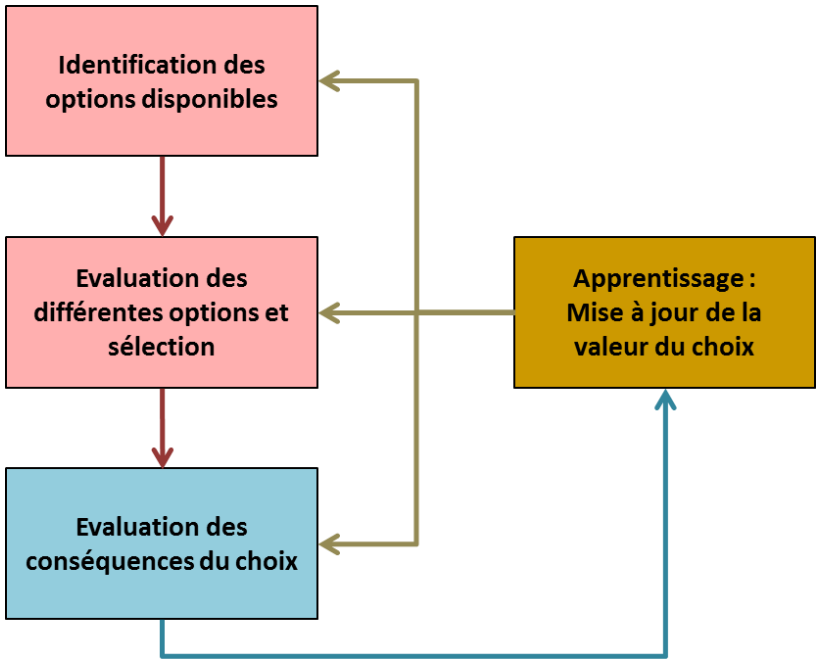


**Figure 5.** Résumé des opérations ayant lieu avant, pendant et après la prise de décision. (D'après Rangel, 2013)

C'est donc au cours de l'étape (2) que s'effectue le choix alimentaire proprement dit. Selon Rangel (2013), cette étape permet de déterminer quelle option, parmi les choix alimentaires possibles, a la valeur la plus élevée pour un individu à l'instant du choix. La **Figure 6** résume comment, toujours selon Rangel (2013), la valeur d'un aliment est déterminée : (1) l'aliment est décomposé en différents attributs « basiques » ou « abstraits », (2) chaque attribut est évalué, et (3) les valeurs de chaque attribut sont compilées pour obtenir une évaluation globale de l'aliment. Ensuite, dans un processus de choix, les valeurs globales de chaque aliment disponible sont comparées pour choisir celui dont la valeur est la plus élevée.

Dans certaines situations de choix, par exemple lorsque vous commandez un croque-monsieur à la basserie et que le serveur vous demande « Avec frites ou salade ? », la valeur globale de chaque aliment peut conduire à un dilemme : vous adorez les frites surtout lorsqu'elles sont bien croustillantes et bien dorées, et il est déjà 13h, vous avez faim ; mais la salade serait une alternative plus sage pour votre ligne et vous vous sentiriez plus léger après le repas. Il faut pourtant faire un choix ! Et le serveur ne va pas attendre bien longtemps que vous vous décidiez… Pour comprendre comment résoudre ce type de conflit, Connors et al.

(2001) ont mis en évidence des stratégies de priorisation de certains critères par rapport à d'autres. Ces stratégies dépendent à la fois des motivations de l'individu et de la situation de consommation (Connors et al., 2001). Lorsqu'un critère n'est pas utilisé pour effectuer un choix, cela ne veut pas dire qu'il ne fait pas partie du système personnel de valeurs alimentaires, mais que pour cet individu, dans cette situation précise de choix alimentaire, ce critère n'est pas pris en compte dans l'évaluation globale de chaque option.

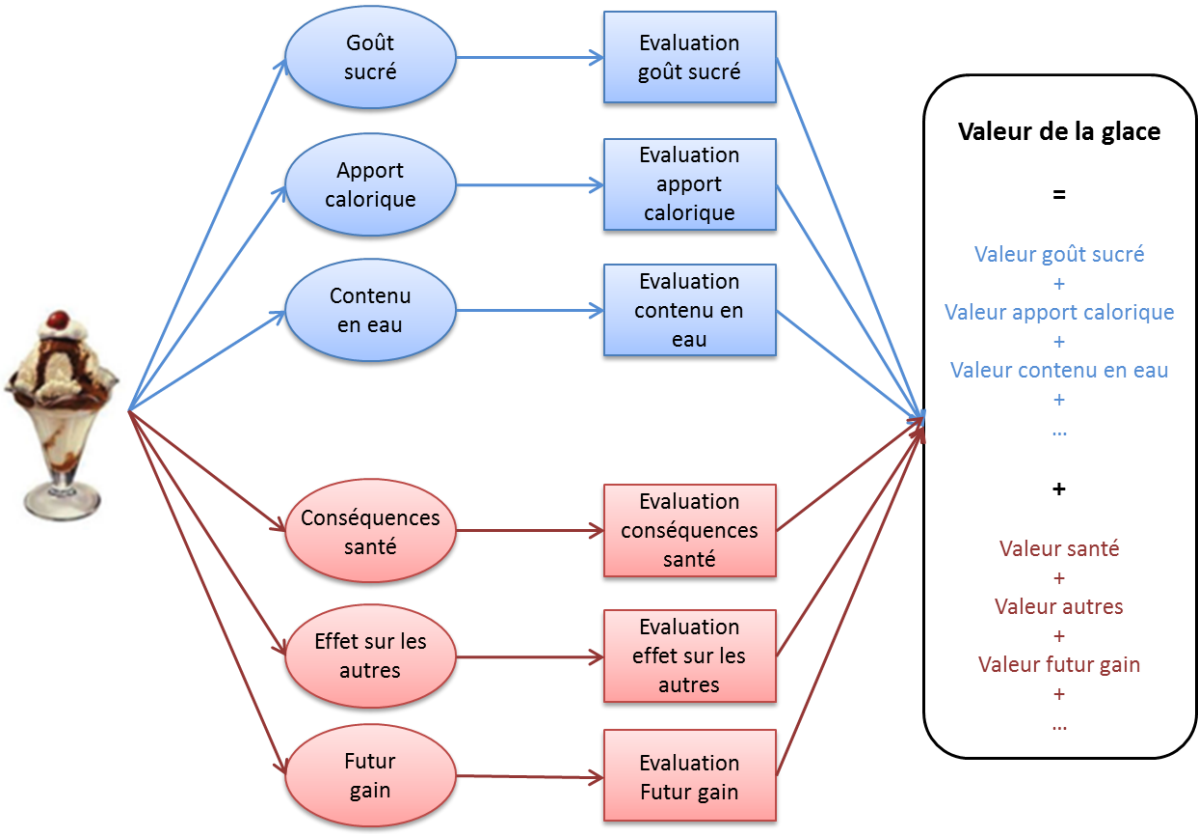


**Figure 6.** Description du système de calcul de la valeur d'un aliment. (D'après Rangel, 2013) En bleu : exemple d'attributs « basiques » ; en rouge : exemple d'attributs « abstraits »

## 2.3. Plaisir, santé et prise de décision alimentaire chez l'enfant

### *2.3.1. Emergence de la prise de décision alimentaire chez l'enfant*

Durant les premiers mois de vie, les aliments que l'enfant consomme ne résultent pas de ses propres choix alimentaires. Jusqu'à 18 mois environ, les enfants acceptent généralement l'ensemble des aliments qui leur est proposé. Puis, des comportements de néophobie et de sélectivité apparaissent. La néophobie désigne la réticence à goûter les produits inconnus, et la sélectivité renvoie à l'acceptation d'un nombre restreint d'aliments

parmi les aliments connus (Nicklaus & Rigal, 2010). En effet, seuls 19% des enfants de quatre à six mois sont perçus comme difficiles par leur mère contre 50% des enfants de 19 à 24 mois (Carruth et al., 2004). De plus, les parents rapportent l'augmentation de comportements néophobiques ou de refus dans l'enfance (Pelchat & Pliner, 1986), en particulier pendant la troisième année (Cashdan, 1994). Ces deux phénomènes concomitants de néophobie et de sélectivité conduisent à une restriction de leur répertoire alimentaire. Ainsi, déjà durant la petite enfance, l'enfant exprime des choix, en privilégiant des aliments plutôt familiers, et affirme ses préférences pour des aliments riches au détriment de certaines catégories d'aliments, notamment les fruits et surtout les légumes (Nicklaus & Rigal, 2010).

En grandissant, les capacités cognitives des enfants se développent et leur relation à l'environnement, notamment alimentaire, évolue (Piaget & Inhelder, 1959). En particulier, Contento (1981) a mis en évidence que, chez les enfants de 6 à 11 ans, émergeait l'idée que les aliments consommés avaient un effet sur leur corps lorsqu'ils étaient dans leur estomac. Entre 6 et 11 ans, les enfants ont donc conscience que les aliments qu'ils consomment peuvent avoir un impact sur leur propre personne, ce qui rend possible leur compréhension de messages « santé » du type de ceux diffusés par le PNNS en France. De plus, les très jeunes enfants sont déjà perméables aux messages publicitaires et marketing. Il a été montré qu'à 2 ans, certains enfants réclament un produit particulier, et les produits alimentaires les plus fréquemment réclamés en premier sont les céréales pour le petit-déjeuner (McNeal, 1999). Vers 7 ans, les enfants commencent à comprendre l'intention de persuasion des messages publicitaires (Blosser & Roberts, 1985; Robertson & Rossiter, 1974), mais l'effet des publicités et des marques s'observe déjà chez les enfants de 3 à 5 ans (McAlister & Cornwell, 2010).

Ainsi, via l'influence de leur environnement, et le développement de nouvelles capacités cognitives, les enfants développent progressivement leurs critères de choix alimentaires. Les enfants ont en effet de multiples occasions d'être impliqués dans un processus de décision de choix alimentaires. Par exemple, en communiquant leurs préférences à leurs parents, il a été montré que les enfants avaient un fort pouvoir décisionnel concernant les aliments disponibles à la maison et leur mode de préparation (Holsten, Deatrick, Kumanyika, Pinto-Martin, & Compher, 2012).

### *2.3.2. Influence des valeurs plaisir et santé sur les choix alimentaires des enfants*

Interrogés sur les facteurs qui influencent leurs choix alimentaires, les enfants et les adolescents déclarent que l'appréciation et la valeur santé d'un aliment sont des critères importants (Fitzgerald et al., 2010). Dès l'âge de 5 ans, les enfants sont capables de classer les aliments en tenant compte à la fois de leur appréciation et de leur valeur santé (Varela & Salvador, 2014). Néanmoins, l'impact de ces capacités de catégorisation sur les choix alimentaires des enfants reste peu exploré. Nguyen et al. (2014) ont étudié l'influence de la perception de la valeur plaisir (i.e., « Combien aimes-tu cet aliment ? ») et de la valeur santé (i.e., « Combien cet aliment est bon pour la santé ? ») sur l'intention de consommer un aliment (i.e., « Mangerais-tu cet aliment ? ») chez des enfants de 4 et 6 ans. Les auteurs ont montré que seule la valeur plaisir perçue d'un aliment prédisait l'intention de le consommer, quel que soit l'âge des enfants (Nguyen et al., 2014). Néanmoins, cette étude comporte plusieurs limites : (1) les auteurs ont mesuré une intention de consommer un aliment, et pas un choix, ni une consommation réelle, (2) certaines caractéristiques individuelles susceptibles d'influencer la prise en compte des critères santé et/ou plaisir lors d'un choix alimentaire ne sont pas prises en compte (e.g., le statut pondéral, la restriction, l'intérêt pour la nutrition), et (3) les intentions de choix ne sont pas liées à un contexte de consommation particulier, la question posée aux enfants est générale.

Dans ce travail de thèse, nous faisons l'hypothèse que l'influence des valeurs plaisir et santé sur les choix alimentaires des enfants pourrait être modulée à la fois par les attitudes des enfants et par le contexte de consommation. Comme cela a été déjà proposé chez l'adulte (Connors et al., 2001), la nature des choix alimentaires d'un enfant pourrait dépendre à la fois de sa propre tendance à accorder plus ou moins d'importance au plaisir ou à la santé, et à la fois du contexte dans lequel il effectue son choix. Afin d'étudier ces deux aspects, d'une part nous mesurerons le caractère plus ou moins hédonique ou nutritionnel des attitudes des enfants envers l'alimentation avant de faire le lien avec la nature de leurs choix alimentaires ; d'autre part, nous comparerons les choix alimentaires des enfants dans différents contextes de consommation, orientés plaisir ou santé.

# 3. Attitudes et choix alimentaires

## 3.1. Qu'est qu'une attitude ?

### *3.1.1. Définition des attitudes*

Comment imaginer notre vie sans attitudes s'interrogent Fazio et Olson (Fazio & Olson, 2003) ? Comment imaginer notre vie sans être capable de classer ce qui nous entoure en termes de « bon » ou « mauvais », « positif » ou « négatif », « à approcher » ou « à éviter » ? Nous évoluerions dans un environnement vide de sens et notre existence dans ce monde serait chaotique et probablement assez courte.

Au début du XX$^{ème}$ siècle, le comportementalisme (ou béhaviorisme) voit le jour comme un courant nouveau en psychologie visant à expliquer les comportements humains uniquement comme des réponses à des stimuli de l'environnement, sans faire appel au psychisme de l'individu considéré comme une « boîte noire ». Ce courant apparaît en opposition à des approches imputant au mental la cause de toute action, et défendant l'introspection en tant que méthode d'accès à la compréhension de l'esprit humain et des comportements. Cependant, les psychologues du courant béhavioriste observent rapidement que la réaction à un stimulus dépend aussi de certaines dispositions mentales des individus, et la notion d'attitude apparaît pour expliquer la relation entre stimulus et réponse comportementale.

La notion d'attitude remonte aux travaux de Thomas et Znaniecki (1918) sur la façon dont les paysans polonais s'intégraient aux Etats-Unis ou en Europe. Ils observent que les paysans polonais manifestent des comportements inadéquats par rapport aux normes sociales de la société d'accueil. Les auteurs notent alors qu'il n'est pas seulement question d'environnement, que pour comprendre les comportements de cette population, il est nécessaire de savoir comment les individus définissent les situations auxquelles ils sont confrontés. Cette définition dépend des attitudes que les individus ont à l'égard des objets qui constituent leur environnement. Toujours selon les auteurs, les attitudes permettent d'expliquer les réactions de l'individu devant les stimulations sociales. Les attitudes constituent donc des dispositions mentales explicatives du comportement.

Dès lors, la notion d'attitude apparaît comme une notion fondamentale mais vague dans le champ de la psychologie et il restait à la définir plus précisément. L'une des définitions les plus communément acceptée est celle d'Allport (1935) qui définit une attitude comme « une prédisposition mentale, construite par l'expérience individuelle, qui exerce une influence sur la réponse de l'individu face à tous les objets et à toutes les situations qui s'y rapportent ». Une attitude a donc une valence (positive ou négative) et peut être liée à tous types d'objets (matériels ou immatériels). Elle constitue finalement la variable intermédiaire entre un objet et la réponse d'un individu face à cet objet. Dans cette lignée, et jusque dans les

années 60, les attitudes ont été étudiées comme un concept unidimensionnel qui variait en intensité positive ou négative par rapport à un objet (Thurstone, 1928).

Au début des années 60, certains auteurs décomposent la notion d'attitude, qui jusque-là était seulement envisagée comme l'évaluation globale d'un objet, en trois composantes (Katz & Stotland, 1959; Rosenberg & Hovland, 1960).

- Une *composante cognitive* qui fait référence aux connaissances et croyances que l'individu a concernant un objet.
- Une *composante affective* qui concerne les émotions, les ressentis subjectifs, positifs ou négatifs que l'individu a à l'égard d'un objet.
- Une *composante conative* qui est relative aux comportements passés et présents de l'individu face à un objet.

Selon cette *théorie tripartite* des attitudes, l'évaluation globale d'un objet se reflète dans ces trois composantes (Breckler, 1984; Kothandapani, 1971; Ostrom, 1969). Fazio et Olson l'illustrent très bien avec l'exemple du chocolat (Fazio & Olson, 2003). Une attitude positive par rapport au chocolat peut transparaître par des croyances (« Un carré de bon chocolat illumine vraiment ma journée. »), des émotions (« Le chocolat qui fond dans ma bouche me procure un sentiment de bien-être. »), et des comportements (« Je suis en train de manger du chocolat »).

Dans le but d'étudier plus précisément les relations entre attitudes et comportements, certains auteurs ont réexaminé le modèle tripartite (Fazio, 1990, 1995; Fazio, Chen, McDonel, & Sherman, 1982; Zanna & Rempel, 1988). En effet, dans sa définition initiale les trois composantes cognitives, affectives et comportementales étaient considérées comme trois manifestations d'une même attitude. Cette définition présumait la coexistence des trois composantes ainsi que leur cohérence. Si une attitude envers un objet était positive (comme dans l'exemple précédent du chocolat), alors les croyances, les émotions et les comportements associés à cet objet devaient traduire cet élan positif envers l'objet en question. Cette définition impliquait donc une cohérence indiscutable entre attitude et comportement. Or, de nombreuses études se sont heurtées à des incohérences entre la mesure des attitudes et des comportements (Zanna & Fazio, 1982). Les observations empiriques ne permettant pas de valider la théorie tripartite, Fazio et al. (1982) ont proposé un nouveau cadre théorique pour l'étude des attitudes. Selon ces auteurs, les attitudes sont des associations présentes dans la mémoire des individus entre des objets et leur évaluation. Ces associations sont basées sur des considérations cognitives, affectives ou comportementales desquelles résulte une évaluation

globale. Les considérations cognitives, affectives et comportementales ne sont plus les « composantes » des attitudes mais leurs « bases ». L'évaluation globale d'un objet peut découler de n'importe quelle combinaison de ces trois bases. Cette évaluation globale influence ensuite les comportements envers l'objet en question[2] (**Figure 7**).

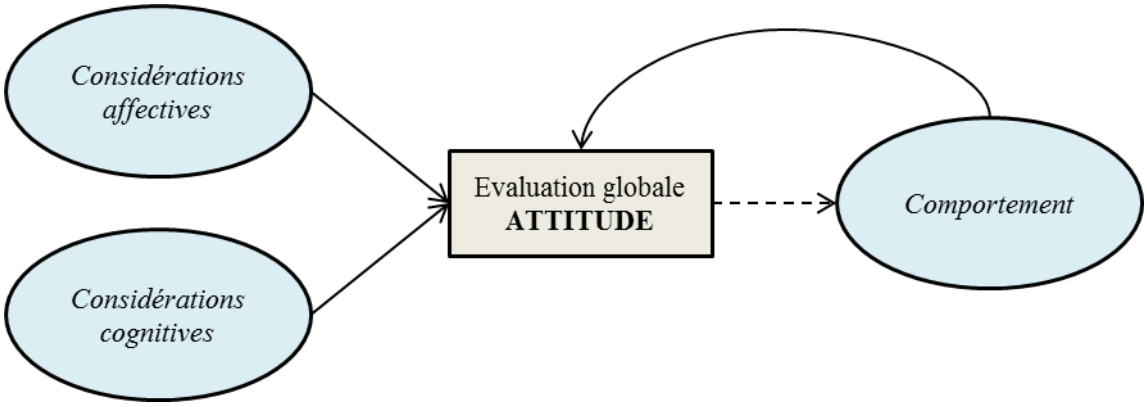


**Figure 7.** Résumé des relations entre attitudes et comportements. (D'après Fazio et al., 1982)

La **Figure 7** pose un premier cadre conceptuel de la définition des attitudes qui est considérée dans ce travail de thèse. Les paragraphes qui suivent viendront compléter et complexifier cette première vision des attitudes et de leur lien avec les comportements.

### *3.1.2. Bases affectives et cognitives des attitudes*

Le fait de ne pas considérer le comportement comme une composante de l'attitude mais comme une conséquence de celle-ci offre de nouvelles perspectives pour la recherche sur les attitudes. En effet, de nombreux auteurs ont focalisé leurs travaux sur les composantes affectives et cognitives des attitudes et leur influence respective sur les comportements (Abelson, Kinder, Peters, & Fiske, 1982; Bagozzi & Burnkrant, 1980; Crites, Fabrigar, & Petty, 1994; Millar & Tesser, 1986, 1989). Nous développons ici l'étude de Millar et Tesser (1986) pour illustrer les apports de l'étude des bases affectives et cognitives des attitudes.

Millar et Tesser (1986) proposent de tester expérimentalement le fait que les comportements puissent être guidés à la fois par des considérations cognitives et par des considérations affectives. Conformément à la définition historique, les auteurs considèrent que la base cognitive des attitudes représente les croyances associés à cet objet, et que la base affective représente les sentiments associés à un objet. Ils font l'hypothèse que les bases

[2] Les modèles de prédiction des comportements par les attitudes (avec un focus sur le domaine de l'alimentation) seront développés au paragraphe 4. de cette introduction.

cognitives ou affectives des attitudes seraient associées à des comportements différents. Dans leur étude, les participants étaient informés qu'ils devraient, à l'issue de la séance expérimentale, soit effectuer un test concernant leurs capacités analytiques (condition cognitive), soit un test concernant leur sensibilité sociale (condition affective). Les participants devaient évaluer 5 puzzles sur une échelle Likert en 7 points soit après un focus cognitif (e.g., « Décrivez pour quelles raisons vous appréciez ou pas ce puzzle. »), soit après un focus affectif (e.g., « Décrivez comment vous vous sentez vous lorsque vous réalisez ce puzzle. »). Quatre groupes de participants étaient ainsi constitués : condition affective ou cognitive × focus affectif ou cognitif. Ensuite, tous les participants disposaient de quelques minutes pour jouer à leur guise avec les différents puzzles, avant de compléter les tests de capacités analytiques ou de sensibilité sociale. Les résultats montrent que la corrélation entre l'évaluation des puzzles et le temps passé à jouer à chaque puzzle est plus élevée lorsque le focus attitudinal et le type de tests qu'ils auront à réaliser sont congruents (i.e., cognitif-cognitif ou affectif-affectif). Ces résultats suggèrent que la manipulation de la dominance attitudinale affective ou cognitive envers un objet est associée à des comportements différents.

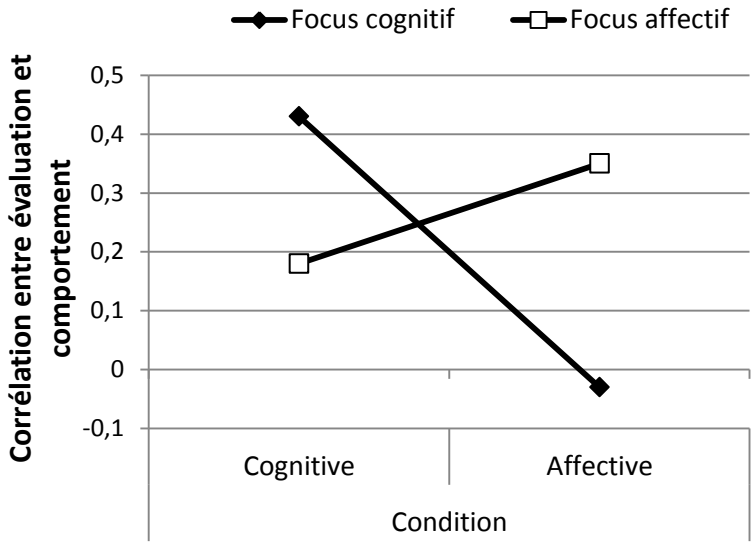


**Figure 8 :** Corrélations entre l'évaluation des puzzles et le temps passé à jouer avec.
(D'après Millar & Tesser, 1986)

### *3.1.3. Nature implicite et explicite des attitudes*

Ce paragraphe ajoute une dimension à la définition des attitudes que nous avons considérée jusqu'ici : la nature « implicite » ou « explicite » des attitudes, termes qui seront définis dans ce paragraphe. Ce qui a été exposé précédemment, notamment la distinction entre

les bases cognitives et affectives des attitudes, reste valable pour les deux types d'attitudes, implicites et explicites.

Selon Fazio et al. (1982), les attitudes sont des associations mémorielles entre des objets et leur évaluation. Les auteurs ajoutent que ces associations peuvent varier en force et, de ce fait, en accessibilité (Fazio et al., 1982). Par exemple, imaginons que l'on ait demandé à deux personnes de noter leur soutien à un candidat lors d'une élection sur une échelle allant de 1 à 10. Imaginons que les deux personnes aient répondu « 2 », l'une en ayant pris le temps de réfléchir quelques instants, de peser les pours et les contres, l'autre ayant spontanément répondu « 2 ! ». Fazio et al. (1982) avancent qu'en dépit de leur équivalence numérique, ces deux attitudes sont différentes : la seconde, spontanée, et activée de manière automatique lorsqu'il est fait mention du candidat, serait plus « forte » que la première. Plus une attitude est forte, c'est-à-dire plus une association entre un objet et son évaluation est accessible en mémoire, plus cette attitude est susceptible d'être activée automatiquement lorsque l'objet attitudinal est rencontré (Fazio, Sanbonmatsu, Powell, & Kardes, 1986). Ce processus automatique d'activation de l'évaluation de l'objet lorsque l'objet en question est rencontré requiert l'existence d'un ensemble d'associations préalablement apprises et stockées en mémoire. Comme le décrivent Fazio et al. (1986), ce phénomène s'inscrit dans le « modèle à diffusion d'activation » de la mémoire, ou « *spreading activation theory* », de Collins & Loftus (1975) qui repose sur l'idée que la mémoire est constituée en un réseau associatif de nœuds – représentant des concepts – interconnectés par des liens. L'activation d'un nœud se diffuse aux autres nœuds auxquels il est connecté (Anderson & Pirolli, 1984). Expérimentalement, cela se traduit par une facilitation (i.e., un traitement plus rapide) des stimuli congruents. Par exemple, Meyer & Schvaneveldt (1971) ont présenté deux chaînes de caractères simultanément à leurs participants et leur ont demandé si elles étaient des mots ou non. Leurs réponses étaient plus rapides lorsque les deux mots présentés ensemble étaient des mots communément associés (e.g., pain-beurre ou infirmière-docteur).

La mémoire constitue le support cognitif des attitudes. Or, Graf et Schacter (1985) introduisent la dichotomie implicite / explicite de la mémoire à long terme. Schacter (1987) définit les mémoires implicite et explicite comme « des processus de récupération d'information stockée en mémoire, implicite quand le processus de récupération est non conscient et non délibéré, explicite quand le processus de récupération est conscient et intentionnel » (Schacter, 1987, cité en français par Ackermann & Mathieu, 2015). Autrement dit, la mémoire explicite désigne notre capacité à réactualiser un évènement du passé. Par

contraste, le terme de mémoire implicite désigne un phénomène dans lequel un épisode antérieur exerce une influence sur le comportement sans que l'évocation consciente de cet épisode ne soit nécessaire (Vinter & Perruchet, 2002). Sur cette base, Greenwald et Banaji (1995) conceptualisent les attitudes explicites comme des associations mémorielles émanant d'expériences passées qui opèrent selon un processus cognitif au cours duquel l'individu est conscient de l'existence et de la valence de l'attitude ; et les attitudes implicites comme des associations mémorielles émanant de « traces » d'expériences passées qui opèrent alors selon un processus automatique, sans effort introspectif conscient de la part de l'individu, et qui peut même opérer sans que l'individu soit conscient de la présence de l'objet générateur d'attitude. Pour résumer notre propos, la **Figure 9**, tirée d'Ackermann et Mathieu (2015), schématise le cadre théorique dans lequel s'inscrit le concept d'attitude implicite.

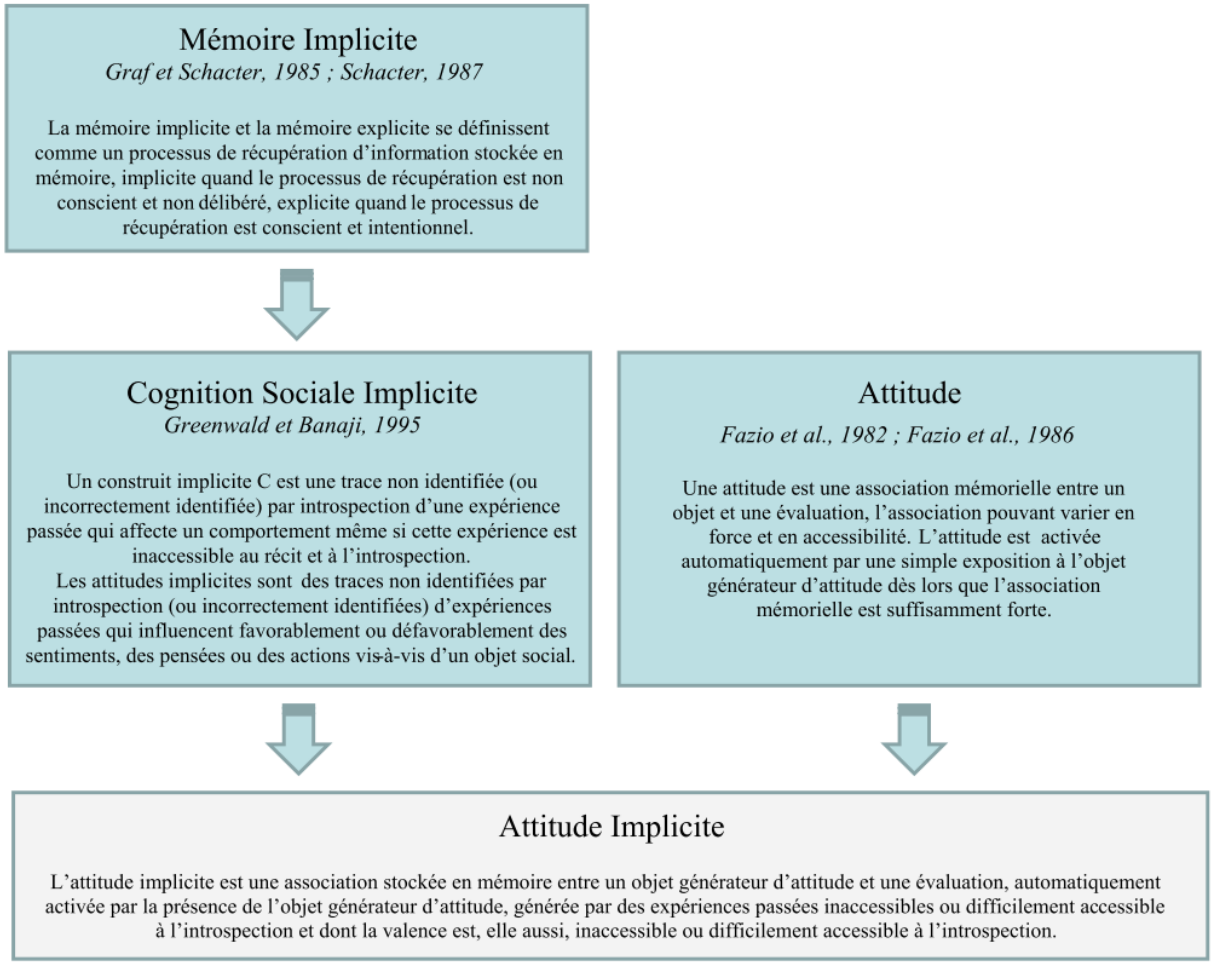


**Figure 9**. Attitude implicite – cadre théorique et définition. (Tiré d'Ackermann & Mathieu, 2015)

### *3.1.4. Les attitudes appliquées au domaine alimentaire*

Dans le domaine alimentaire, il n'y a pas de consensus quant à la définition du terme « attitude ». De nombreux auteurs l'emploient pour désigner les préférences alimentaires (Aaron, Mela, & Evans, 1994; Aikman, Min, & Graham, 2006; Ayres, Conner, Prestwich, & Smith, 2012; Craeynest et al., 2005; Czyzewska & Graham, 2008; Goldstein et al., 2013; Hill, 2002; Roefs & Jansen, 2002), d'autres pour désigner l'intention de consommer ou d'acheter un aliment (Gerson, Goto, Wolff, & Giovanni, 2013; Hori et al., 2001), d'autres encore l'emploient pour parler des motivations à manger (Brown & Ogden, 2004; Hill, 2002; Zarnowiecki, Sinn, Petkov, & Dollman, 2012), du comportement alimentaire déclaré (Aikman et al., 2006; Roefs & Jansen, 2002; Rozin, Fischler, Shields, & Masson, 2006), des croyances envers l'alimentation (Bianchi et al., 2016; Bredahl, 2001; Dreezens, Martijn, Tenbült, Kok, & De Vries, 2005; Gerson et al., 2013), de l'importance de la valeur santé et du plaisir dans l'alimentation (Rodríguez-Arauz, Ramírez-Esparza, & Smith-Castro, 2016; Roininen, Lähteenmäki, & Tuorila, 1999; Rozin et al., 1999), ou bien encore de la restriction (Hill, 2002; Hood et al., 2000) ou même du dégoût (Rozin, Fallon, & Mandell, 1984). Cette liste n'est pas exhaustive mais elle met en évidence la diversité des interprétations de ce que sont les attitudes lorsqu'il est question d'alimentation. Ce manque de consensus dans la définition des attitudes envers l'alimentation entraîne aussi un foisonnement des méthodologies pour les mesurer. Néanmoins ces définitions convergent en un point : elles désignent une interaction entre un individu et un objet alimentaire. Mais la nature de cette interaction ainsi que ses caractéristiques restent floues. Dans ce travail de thèse, la définition adoptée est celle de Fazio (1982) appliquée au domaine alimentaire. Nous présumons donc que les attitudes envers les aliments sont des associations présentes dans la mémoire des individus entre les aliments et leur évaluation.

Les attitudes envers les aliments peuvent être basées sur des considérations affectives et cognitives. En effet, dans le domaine des sciences du consommateur, des différences entre bases affectives et cognitives des attitudes ont été mises en évidence envers des produits (Batra & Ahtola, 1991), des marques (Leclerc, Schmitt, & Dubé, 1994; Park, Milberg, & Lawson, 1991), des publicités (Burke & Edell, 1989; Edell & Burke, 1987), ou bien encore des promotions (Chandon, Wansink, & Laurent, 2000). En particulier, Cantin et Dubé (1999) avancent que dans le domaine alimentaire la base affective des attitudes reflète notamment l'expérience hédonique de la consommation d'un aliment ou le plaisir de partager un repas avec des amis, alors que la base cognitive des attitudes reflète par exemple la perception de la valeur santé d'un aliment ou sa praticité. De plus, les attitudes envers les aliments peuvent

être explicites (i.e., délibérées) ou implicites (i.e., automatiques). En effet, la prise de décision dans le domaine alimentaire repose sur des mécanismes cognitifs plus ou moins réfléchis ou spontanés (Rangel, 2013).

Finalement, les attitudes envers les aliments sont explicites ou implicites et sont basées sur des considérations cognitives ou affectives desquelles résulte une évaluation globale, délibérée ou automatique, à même d'influencer le choix des aliments en question.

## 3.2. Les attitudes comme prédicteurs des choix alimentaires

### *3.2.1. L'étude de la relation attitude-comportement*

Nous avons défini une attitude comme une association mémorielle entre un objet et son évaluation, et cette évaluation est susceptible d'influencer le comportement d'un individu envers cet objet. Selon si l'évaluation d'un objet est positive ou négative, un individu agira de manière favorable ou défavorable envers cet objet. Lorsque la notion d'attitude est apparue en psychologie sociale, son lien avec les comportements faisait partie intégrante de sa définition (Allport, 1935). Néanmoins, de nombreuses études n'ont mis en évidence que de faibles corrélations entre les attitudes et les comportements (pour une revue de la littérature, voir McGuire, 1985). Certains auteurs ont alors proposé d'abandonner le concept même d'attitude en psychologie sociale (LaPiere, 1934; Wicker, 1971), alors que d'autres ont proposé un tournant dans la recherche sur les attitudes : puisque les attitudes prédisaient parfois les comportements et parfois non, il fallait se demander non pas *si* mais *quand* les attitudes prédisaient les comportements (Zanna & Fazio, 1982). Zanna et Fazio (1982) proposaient ainsi de mettre évidence dans quelles conditions on pouvait s'attendre à observer une corrélation entre l'attitude et le comportement envers un objet. Il a notamment été mis en évidence que le contexte pouvait influencer la relation attitude-comportement (Ajzen, 1991; Fishbein & Ajzen, 1975). Au cours des dernières décennies, certains auteurs ont alors redéfini la notion d'attitude comme une « construction momentanée » de manière à prendre en compte ces effets contextuels (Schwarz, 2007). Dans cette perspective, les attitudes sont vues comme des évaluations construites au moment où un individu rencontre un objet, en fonction des informations disponibles à ce moment précis. Dans ce manuscrit nous nous en tiendrons à la définition classique d'une attitude comme un construit stable (Allport, 1935), mais sans nier l'influence du contexte qui sera étudiée indépendamment.

Au paragraphe 2 de cette introduction nous avons décrit le processus de la prise de décision dans le domaine alimentaire. Les modèles présentés n'intégraient pas la notion d'attitude (Connors et al., 2001; Furst et al., 1996; Rangel, 2013; Sobal & Bisogni, 2009). Sans pour autant remettre en cause ce qui a été décrit précédemment, les attitudes, en tant qu'objet conceptuel, constituent l'une des manières d'appréhender les mécanismes psychologiques de la prise de décision. Même si les concepts et le vocabulaire employés dans les deux littératures sont différents, les mécanismes décrits sont proches théoriquement. L'évaluation globale d'un aliment, basée sur l'évaluation de chacun de ses attributs, décrite par Rangel (2013), correspond à la définition d'une attitude envers un aliment basée sur des considérations qui peuvent être affectives et cognitives. La différence théorique entre évaluation globale et attitude est qu'une évaluation globale est décrite comme pouvant varier en fonction du contexte de consommation (Connors et al., 2001), alors que la définition classique d'une attitude implique une certaine stabilité (Fazio & Olson, 2003). Ainsi, dans ce travail de thèse, nous conceptualisons l'attitude comme l'une des composantes de l'évaluation globale d'un aliment. Nous considérons une attitude comme relativement stable et propre à un individu.

### *3.2.2. Mesure des attitudes implicites et explicites et de leurs bases affectives et cognitives dans le domaine alimentaire*

Pour faire le lien entre attitudes implicites et explicites et comportements alimentaires, il faut mesurer les attitudes envers les aliments. Nous présentons les deux méthodes, explicites et implicites, qui sont généralement utilisées dans le domaine alimentaire.

Les attitudes explicites sont mesurées par questionnaires (Perugini, 2005). Ces questionnaires ont pour but de capter la valence de l'évaluation d'un aliment par un individu. Ils comportent généralement plusieurs échelles permettant de mesurer l'évaluation d'un aliment (e.g., mauvais / bon, déplaisant / plaisant, négatif / positif, non-attractif / attractif). Les échelles sont codées numériquement (e.g., de -3 à +3) et l'attitude explicite envers un objet est calculée en faisant la moyenne des scores pour chaque échelle. Si l'on veut comparer les attitudes envers deux aliments distincts, on soustrait alors le score moyen pour un aliment A au score moyen pour un aliment B. On obtient alors une préférence relative pour l'aliment A (e.g., des fruits) par rapport à l'aliment B (e.g., des snacks sucrés). Afin de dissocier les bases affectives et cognitives des attitudes explicites, certains auteurs ont développé des échelles

séparées comportant respectivement des termes affectifs, tels que déplaisant / plaisant ou non-appréciable / appréciable, ou des termes cognitifs, tels que pas raisonnable / raisonnable ou mauvais pour la santé / bon pour la santé (Ayres et al., 2012; Dubé & Cantin, 2000). De la même manière que pour l'attitude globale, on calcule alors les scores affectif et cognitif en faisant la moyenne des échelles pour un aliment donné.

Le test d'association implicite ou IAT (Implicit Association Test; Greenwald, McGhee, & Schwartz, 1998; Greenwald, Nosek, & Banaji, 2003) est couramment utilisé pour mesurer les attitudes implicites, notamment dans le domaine alimentaire (Hofmann, Friese, & Roefs, 2009; Perugini, 2005; Richetin, Perugini, Prestwich, & O'Gorman, 2007; Roefs & Jansen, 2002; Trendel & Werle, 2016). Il permet de mesurer l'attitude implicite envers un aliment en accédant à l'évaluation automatiquement activée par cet aliment. Il s'agit d'une mesure relative, mesurant la différence entre l'attitude implicite à l'égard d'un aliment A et l'attitude implicite à l'égard d'un aliment B. Comme l'expliquent Ackermann & Mathieu (2015), au cours d'un IAT, il est demandé au participant de catégoriser des stimuli selon qu'ils correspondent à une catégorie d'aliments A (e.g., « fruits »), une catégorie d'aliments B (e.g., « snacks sucrés »), un attribut positif (e.g., « positif ») ou un attribut négatif (e.g., « négatif »). Pour ce faire, les participants doivent appuyer le plus rapidement possible sur une touche située à gauche du clavier de l'ordinateur pour les stimuli correspondant à un aliment ou un attribut (e.g., « fruits » et « positif ») et sur une touche située à droite du clavier de l'ordinateur pour les stimuli correspondant à l'autre aliment ou l'autre attribut (e.g., « snacks sucrés » et « négatif »). Il est ensuite demandé aux participants d'effectuer une seconde tâche de catégorisation, mais en utilisant cette fois-ci les touches du clavier de l'ordinateur de manière inversée pour catégoriser les aliments et les attributs. Si le participant effectue plus rapidement la tâche où « fruits » et « positif » sont associés que celle où « snacks sucrés » et « positif » sont associés, cela traduit une attitude implicite plus favorable à l'égard des fruits qu'à l'égard des snacks sucrés.

Ce n'est que récemment que l'IAT a été adapté pour la mesure respective des bases affectives et cognitives des attitudes dans le domaine alimentaire (Trendel & Werle, 2016). De manière symétrique à la mesure des bases affectives et cognitives des attitudes explicites, Trendel & Werle (2016) ont remplacé les attributs évaluatifs (i.e., « négatif » et « positif ») par des attributs attachés exclusivement à la composante affective (i.e., « mauvais au goût » et « bon au goût ») ou cognitive (i.e., « mauvais pour la santé » et « bon pour la santé »). La méthode expérimentale et de traitement des données est similaire à l'IAT évaluatif mais

l'interprétation change. Les catégories d'aliments utilisées par Trendel & Werle (2016) étaient « pomme » et « chocolat ». Si le participant effectuait plus rapidement la tâche où « pomme » et « bon au goût » étaient associés que celle où « chocolat » et « bon au goût » étaient associés, cela traduisait une préférence affective implicite pour la pomme par rapport au chocolat. De façon similaire, si le participant effectuait plus rapidement la tâche où « pomme » et « bon pour la santé » étaient associés que celle où « chocolat » et « bon pour la santé » étaient associés, cela traduisait une préférence cognitive implicite pour la pomme par rapport au chocolat.

Dans l'introduction de ce manuscrit, la majorité des études présentées impliquant la mesure d'attitudes implicites ou explicites, et de leurs bases affectives ou cognitives utilisent les méthodes présentées ci-dessus (i.e., questionnaire pour les attitudes explicites et IAT pour les attitudes implicites).

### *3.2.3. Influences des bases affectives et cognitives des attitudes explicites et implicites sur les comportements alimentaires*

Au moyen de questionnaires chez l'adulte, Dubé et Cantin (1999) ont montré que les bases affectives (e.g., « Combien cette boisson est : goûteuse, rafraîchissante, fade ? ») et cognitives (e.g., « Combien cette boisson est bonne pour la santé, nutritive, vitaminée ? ») des attitudes explicites envers une boisson étaient toutes les deux associées à l'appréciation de cette boisson (i.e., « Combien appréciez-vous cette boisson ? ») et à sa consommation (i.e., « Combien de fois avez-vous consommé cette boisson au cours des sept derniers jours ? ») (Cantin & Dubé, 1999). De plus, il a été montré chez l'adulte que des attitudes explicites à dominance affective rendaient plus perméable aux messages de persuasion (e.g., publicités, marketing), d'autant plus lorsque ces messages utilisaient des arguments affectifs (Fabrigar & Petty, 1999), modifiant notamment les intentions de consommation (Dubé & Cantin, 2000).

Concernant les attitudes implicites, Trendel et Werle (2016) ont mesuré leurs bases affectives et cognitives au moyen d'un IAT dans le but d'étudier leur influence respective sur les choix alimentaires. Pour ce faire, les auteurs ont comparé les associations implicites entre les pommes et le plaisir avec les associations implicites entre le chocolat et le plaisir. Ils ont aussi comparé les associations implicites entre les pommes et la santé avec les associations implicites entre le chocolat et la santé. De plus, ils ont comparé l'évaluation globale des pommes et du chocolat et ont demandé aux participants de choisir entre une pomme et une

barre chocolatée. Les résultats ont montré que la différence dans l'évaluation globale des pommes par rapport au chocolat était influencée à la fois par la différence implicite en termes de plaisir (i.e., la base affective des attitudes implicites) et par la différence implicite en termes de santé (i.e., la base cognitive des attitudes implicites) perçues pour les pommes par rapport au chocolat. De plus, cette étude a mis en évidence que soit la base affective, soit la base cognitive des attitudes implicites pouvaient prédire à elle seule le choix d'une pomme ou d'une barre chocolatée en fonction du contexte et de caractéristiques individuelles : lorsque les participants étaient distraits par une tâche cognitive au moment de leur choix (i.e., se rappeler d'une série de nombre), seule la base affective des attitudes implicites prédisait leur choix ; à l'inverse, lorsque les participants n'étaient pas distraits, ceux qui se déclaraient comme faiblement impulsifs ne basaient leur choix que sur la base cognitive des attitudes implicites.

En résumé, dans le domaine alimentaire, il semblerait d'une part qu'à la fois les bases affectives et cognitives des attitudes explicites et implicites influencent les comportements, d'autre part que la dominance relative d'une base par rapport à l'autre à un instant donné puisse se traduire par des comportements différents.

### *3.2.4. Interactions entre les attitudes implicites et explicites dans la prédiction des comportements alimentaires*

#### 3.2.4.1. Trois modèles d'interaction des attitudes implicites et explicites

D'un point de vue théorique, les liens entre attitudes implicites et explicites font débat. Certains auteurs avancent qu'il n'y a qu'une seule attitude, que seules varient les méthodes pour la mesurer, qui elles peuvent être implicites ou explicites (Fazio, 1990, 2007; Fazio & Olson, 2003). Au contraire, d'autres avancent qu'il existe à la fois une attitude implicite et explicite envers le même objet qui sont indépendantes l'une de l'autre (Wilson, Lindsey, & Schooler, 2000). D'autres auteurs enfin, proposent des modèles intermédiaires dans lesquels les attitudes implicites et explicites sont distinctes mais liées (Gawronski & Bodenhausen, 2006; Greenwald & Banaji, 1995; Nosek, 2007; Strack & Deutsch, 2004). Dans ce paragraphe, nous explorons les liens entre les attitudes implicites et explicites en prenant en compte successivement ces trois modèles différents.

Selon Fazio (2007), il n'y a pas *une* attitude implicite et *une* attitude explicite envers le même objet, mais simplement *une* attitude envers un objet qui peut être potentiellement activée automatiquement. Une attitude est toujours considérée comme une association stockée en mémoire entre un objet et son évaluation. Toujours selon Fazio (2007), cette association varie en force le long d'un continuum. Une extrémité de ce continuum est la « non-attitude », c'est-à-dire une indifférence envers l'objet rencontré (e.g., l'objet est inconnu ou ne suscite pas d'intérêt particulier). Lorsqu'on se déplace vers l'autre extrémité de ce continuum, non seulement des évaluations deviennent disponibles mais elles sont de plus en plus fortement attachées aux objets qu'elles concernent. Plus l'association entre une évaluation et un objet est forte, plus elle est susceptible d'être activée de manière automatique lorsque l'objet est rencontré. Seule une attitude assez forte pourra donc être mesurée implicitement. Néanmoins, il arrive que la valence de l'attitude explicite (c'est-à-dire une attitude rapportée de manière délibérée) diffère de la valence de l'attitude mesurée implicitement. Olson et Fazio (2009) expliquent la possibilité de cette divergence par le modèle MODE, selon lequel la Motivation et l'Opportunité DEterminent si l'attitude guide le comportement selon un processus spontané ou délibéré. Pour illustrer ce modèle, Fazio & Olson (Fazio & Olson, 2003) prennent l'exemple d'un amateur de chocolat. Cet amateur de chocolat peut n'avoir que rarement l'opportunité ou le temps d'entrer dans la boutique d'un chocolatier de renom. En ces circonstances, il va certainement évaluer toutes les options qui s'offrent à lui avant de décider d'acheter telle ou telle sorte de chocolat. Il va avoir envie de faire le bon choix, et pour cela il va sans doute pondérer minutieusement les attributs de chacun des chocolats qu'il pourrait acheter. Néanmoins, dans d'autres circonstances, à la caisse d'un supermarché, lorsqu'il est pressé, ce même amateur de chocolat pourra acheter spontanément une barre chocolatée. Il n'en aura pas évalué tous les attributs, mais sa simple vue aura activé automatiquement son attitude positive envers le chocolat, conduisant à son achat. Selon Olson et Fazio (2009), mesurer une attitude explicite consiste à mesurer un comportement : on demande aux sujets de reporter de manière délibérée une attitude qui aurait pu, dans certains cas, être aussi mesurée implicitement. Selon le modèle MODE, le comportement de rapporter une attitude, via un questionnaire par exemple, est alors guidé par l'attitude automatiquement activée, ou, si l'opportunité se présente, par des facteurs motivationnels (Fazio, 1990). Les auteurs attachent la notion d'effort au terme motivation : par exemple atteindre un but précis, prendre la bonne décision, faire de son mieux – comme dans la boutique du bon chocolatier. De plus, ils avancent que le contexte d'un comportement donne plus ou moins l'opportunité d'exprimer ces motivations. De ce fait, des conditions de faible motivation conduisent à une

convergence entre la valence de l'attitude automatiquement activée et celle de l'attitude rapportée (i.e., du comportement). Au contraire, des conditions qui offrent l'opportunité de laisser transparaître les motivations d'un individu peuvent conduire à une divergence entre ces dernières. Ainsi, Olson et Fazio (M. Olson & Fazio, 2009) démontrent qu'une divergence entre attitude automatiquement activée et attitude rapportée ne signifie pas forcément qu'il existe deux construits différents stockés en mémoire.

A l'opposé de cette vision, Wilson et al. (2000) proposent l'existence d'attitudes duales à l'égard du même objet, c'est-à-dire d'une attitude implicite, stockée dans la mémoire implicite et inaccessible à la conscience, et d'une attitude explicite, accessible à l'introspection. Selon ces auteurs, l'attitude implicite est activée automatiquement quand l'individu rencontre l'objet générateur d'attitude ; si les individus ont la capacité cognitive et la motivation de mobiliser leur attitude explicite stockée en mémoire, alors celle-ci peut surpasser l'attitude implicite. Les attitudes implicites influenceraient donc les réponses spontanées et automatiques envers un objet, tandis que les attitudes explicites influenceraient au contraire les réponses délibérées et réfléchies. Selon Wilson et al. (2000), les tâches implicites et explicites permettent d'accéder respectivement à l'une ou l'autre des attitudes. L'existence de deux attitudes envers un même objet stockées en mémoire admet qu'elles puissent être congruentes (i.e., toutes les deux positives ou toutes les deux négatives), ou incongruentes (i.e., l'une positive, l'autre négative). De plus, cette théorie admet aussi que les attitudes aussi bien explicites qu'implicites puissent être basées sur des considérations affectives ou cognitives.

Enfin, la dernière vision des interactions entres attitudes implicites et explicites est une vision intermédiaire qui postule que les attitudes implicites et explicites puissent être différentes mais néanmoins liées. Plusieurs auteurs ont proposé des modèles qui tiennent compte de ces interactions potentielles (Gawronski & Bodenhausen, 2006; Greenwald & Banaji, 1995; Nosek, 2007; Strack & Deutsch, 2004). Par exemple, Greenwald et Banaji (1995) postulent que les attitudes implicites et explicites prédisent tous les comportements, qui sont considérés comme la conséquence de l'interaction entre cognition implicite et explicite. En outre, ils proposent que l'attention modère la cognition implicite. Gawronski et Bodenhausen (2006) se sont basés sur les travaux de Strack et Deutsch (2004) et suggèrent quant à eux que les attitudes explicites et implicites sont issues de deux mécanismes cognitifs différents : le raisonnement par propositions et l'activation d'associations. Néanmoins, ils considèrent que ces mécanismes sont intrinsèquement liés. Selon leur modèle, un jugement

spontané découle de l'attitude implicite, et ce jugement constitue une proposition (e.g., « Je n'aime pas X »). La validité de cette proposition est ensuite évaluée de manière rationnelle en incluant d'autres informations, et ce processus aboutit à la formation de l'attitude explicite.

Globalement, comme l'illustrent Ackermann et Mathieu (2015), tous ces modèles proposent un cadre conceptuel expliquant dans quelles conditions l'expression d'un jugement évaluatif sera le fruit de l'activation automatique de l'attitude stockée en mémoire et/ou d'un processus de réflexion délibéré (**Figure 10)**.

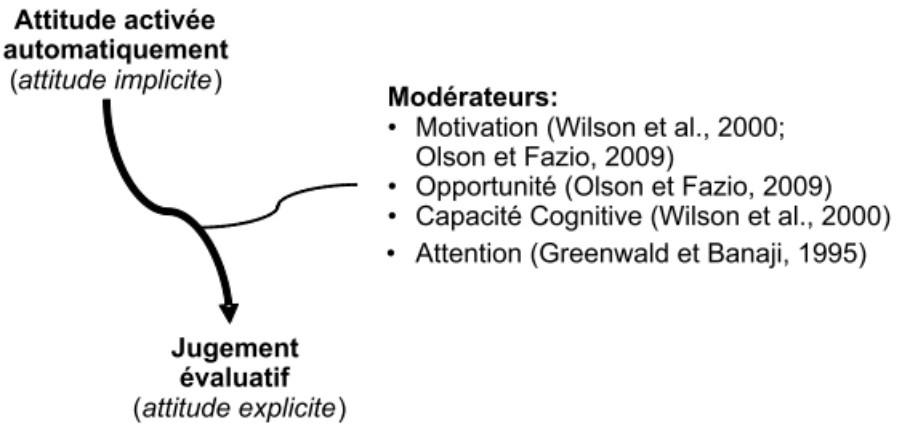


**Figure 10.** Variables modérant l'association entre l'attitude implicite et l'attitude explicite. (Tiré d'Ackermann & Mathieu, 2015)

#### 3.2.4.2. Comparaison des trois modèles prédictifs dans le domaine alimentaire

Perugini (2005) a testé expérimentalement ces trois modèles d'interaction des attitudes implicites et explicites dans le cadre de la prédiction d'un choix alimentaire. Selon lui, le modèle basé sur les travaux de Fazio, qualifié d'*additif*, devrait se traduire par une influence conjointe, mais indépendante, des mesures implicites et explicites d'une attitude sur un choix alimentaire ; le modèle basé sur les travaux de Wilson et al. (2000), qualifié de *dual*, devrait se traduire par l'influence unique soit de l'attitude implicite, soit de l'attitude explicite, en fonction du type de choix alimentaire, respectivement spontané ou délibéré ; le modèle basé sur les travaux de Strack et Deutsch (2004), qualifié d'*interactif*, devrait se traduire par une interaction synergique des attitudes implicites et explicites pour prédire un choix alimentaire. Pour tester ces trois modèles, Perugini (2005) a comparé les attitudes implicites et explicites pour des fruits et des snacks sucrés. Les attitudes implicites ont été mesurées au moyen d'un IAT, et les attitudes explicites au moyen de questionnaires. De plus, il a enregistré deux comportements alimentaires, l'un supposé spontané (i.e., le choix d'un fruit ou d'un snack à la

fin de la session expérimentale) et l'autre délibéré (i.e., la consommation moyenne déclarée de fruits vs. de snacks sucrés). Les résultats de cette étude sont en faveur du modèle *dual*. En effet, ils ont mis en évidence que les attitudes implicites prédisaient significativement le comportement spontané (i.e., le choix réel d'un aliment) mais pas le comportement délibéré (i.e., la consommation antérieure des aliments), et inversement pour les attitudes explicites.

Friese et al. (2008) ont mesuré les attitudes implicites (via un IAT) et explicites (via un questionnaire) envers des fruits par rapport à des barres chocolatées chez des adultes (Etude 1). Ensuite, les participants devaient choisir cinq aliments parmi un assortiment de 20 fruits ou barres chocolatées. Lors de ce choix alimentaire, les participants étaient affectés aléatoirement à une condition de charge cognitive faible ou élevée : ils devaient respectivement soit mémoriser un chiffre, soit mémoriser un nombre à huit chiffres. Les auteurs ont analysé l'influence des attitudes implicites et explicites sur les choix alimentaires dans les deux conditions. Ils ont montré que les attitudes explicites prédisaient les choix alimentaires dans une condition de charge cognitive faible, tandis que les attitudes implicites prédisaient les choix alimentaires dans une condition de charge cognitive élevée. Lors d'une autre étude, Friese et al. (2008) ont mesuré les attitudes implicites et explicites envers des chips chez l'adulte (Etude 2). Pour ce faire, Friese et al. (2008) ont utilisé une version de l'IAT adaptée pour un seul objet : le SC-IAT (Andrew Karpinski & Steinman, 2006) et un questionnaire. Les auteurs ont ensuite manipulé la capacité de contrôle des participants qui devaient regarder un film soit en contrôlant leurs émotions de manière à ce que quelqu'un qui les observe ne puisse pas deviner si le film en question était joyeux ou triste, soit en laissant s'exprimer leurs émotions. Les participants dans la première condition étaient supposés avoir des capacités de contrôle réduites suite au visionnage du film. Les participants disposaient alors de 6 minutes pour manger des chips et la quantité consommée était enregistrée. Les auteurs ont analysé l'influence des attitudes implicites et explicites sur la quantité de chips consommée dans les deux conditions. Ils ont montré que les attitudes explicites prédisaient les quantités de chips consommées lorsque les capacités de contrôle sont normales, mais que les attitudes implicites prédisaient les quantités de chips consommées lorsque les capacités de contrôle sont réduites.

Selon les études chez l'adulte présentées précédemment, il semblerait qu'en fonction de la situation l'attitude implicite ou explicite envers un aliment prédise le comportement alimentaire (Friese et al., 2008; Perugini, 2005). Néanmoins, d'autres études présentées au paragraphe suivant ont mis en évidence que ce pattern n'est pas toujours vérifié (Ayres et al.,

2012; König, Giese, Schupp, & Renner, 2016). Les interactions entre attitudes implicites et explicites dans la prédiction des choix alimentaires semblent aussi dépendre de l'environnement alimentaire et des individus.

#### 3.2.4.3. Modérateurs de l'interaction des attitudes implicites et explicites dans la prédiction des choix alimentaires

König et al. (2016) ont testé chez l'adulte l'influence des attitudes implicites (mesurées via un IAT) et explicites (mesurées via un questionnaire) sur les choix alimentaires de fruits ou de confiseries dans deux conditions expérimentales : une condition de choix binaires (i.e., plusieurs choix successifs sur ordinateur entre un fruit et une confiserie) et une condition de choix multiples (i.e., choix à volonté de fruits ou de confiseries sur un buffet fictif). Les résultats ont montré que dans les deux conditions les attitudes implicites et explicites prédisaient les choix alimentaires : de manière indépendante dans la condition de choix binaires et de manière interactive dans la condition de choix multiples. L'environnement alimentaire, en particulier le nombre d'aliments disponibles lors du choix, semble donc influencer le pattern d'interactions entre les attitudes implicites et explicites dans la prédiction des choix alimentaires.

Ayres et al. (2012) ont mesuré à la fois les attitudes implicites (via un IAT) et les composantes affectives et cognitives des attitudes explicites (par questionnaires) envers des fruits ou du chocolat, avant de demander aux participants de choisir entre un fruit et une barre chocolatée. Les résultats montrent une corrélation entre les attitudes implicites et la composante affective des attitudes explicites. De plus, ils mettent en évidence que si les attitudes implicites prédisent les choix alimentaires, cet effet est annulé par l'introduction de la composante affective des attitudes explicites dans les modèles de prédiction du choix. Les auteurs en concluent que la variable la plus prédictive des choix alimentaires serait la composante affective des attitudes explicites envers un aliment. Néanmoins, ces résultats ont été obtenus chez de jeunes adultes normo-pondéraux et il faut être prudent quant à leur généralisation. En effet, une autre étude incluant des adultes obèses a mis en évidence une corrélation entre attitudes implicites et composante cognitive des attitudes explicites (Roefs & Jansen, 2002). Cette dernière étude n'incluait pas de mesure comportementale. On peut cependant supposer que des différences individuelles quant aux corrélations entre les

composantes des attitudes implicites et explicites envers l'alimentation pourraient conduire à des différences concernant la prédiction des comportements alimentaires.

Pour synthétiser ces différents modèles théoriques appliqués au domaine alimentaire, nous considérons les attitudes implicites envers les aliments comme des jugements évaluatifs des aliments émanant d'un raisonnement associatif basé sur la récupération de traces d'expériences alimentaires passées et influençant les choix alimentaires spontanés, et les attitudes explicites envers les aliments comme des jugements évaluatifs des aliments émanant d'une réflexion aussi basée sur des expériences alimentaires passées et influençant les choix alimentaires délibérés.

## 3.3. Caractériser un profil attitudinal santé/plaisir envers l'alimentation chez l'enfant

### *3.3.1. Définition du profil attitudinal santé/plaisir*

Comme présenté au début de cette introduction, ce travail de thèse s'intéresse en particulier à l'importance qu'accordent les enfants au plaisir et à la santé lorsqu'il est question d'alimentation. La théorie des attitudes présentée ci-dessus offre un cadre de réflexion intéressant à ce sujet. En effet, les considérations liées au plaisir peuvent être rapprochées des bases affectives des attitudes envers l'alimentation, tandis que les considérations liées à la santé peuvent être rapprochées de leurs bases cognitives (Dubé & Cantin, 2000). Nous proposons donc de caractériser un profil attitudinal envers l'alimentation chez l'enfant afin de mesurer la dominance du plaisir ou de la santé dans le rapport de l'enfant à son alimentation. Ce profil attitudinal sera constitué d'un profil implicite et d'un profil explicite qui refléteront respectivement la dominance relative implicite ou explicite du plaisir par rapport à la santé ou vice-versa. En effet, nous avons vu que les attitudes implicites et explicites ont des bases cognitives ou affectives. Une dominance affective (ou cognitive) des attitudes implicites implique que l'évaluation spontanée d'un aliment soit basée principalement sur des critères affectifs (ou cognitifs). Une dominance affective (ou cognitive) des attitudes explicites implique que l'évaluation réfléchie d'un aliment soit basée principalement sur des critères affectifs (ou cognitifs).

Dans le cadre de la problématique de cette thèse, ce profil attitudinal postule que les bases affectives des attitudes sont liées au plaisir, et leurs bases cognitives à la santé. Nous ne nions pas que les bases affectives et cognitives des attitudes envers l'alimentation soient aussi

influencées par d'autres facteurs, par exemple la commensalité ou les émotions pour les bases affectives, et la praticité pour les bases cognitives. Néanmoins, dans ce travail de thèse lorsque nous parlerons de dominance affective du profil attitudinal, nous entendrons dominance du plaisir par rapport à la santé, et lorsque nous parlerons de dominance cognitive du profil attitudinal, nous entendrons dominance de la santé par rapport au plaisir. La **Figure 11** illustre cette notion de profil attitudinal.

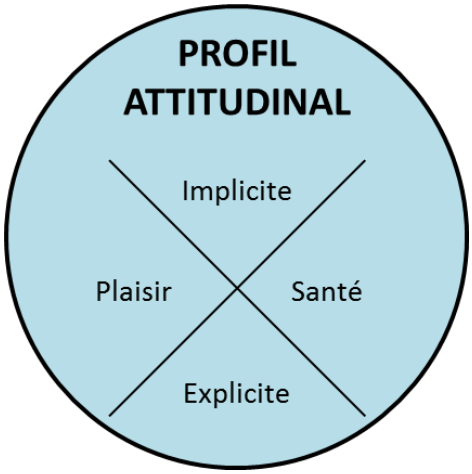


**Figure 11.** Les composantes du profil attitudinal

### *3.3.2. Liens potentiels entre profil attitudinal santé/plaisir, attitudes et choix alimentaires chez l'enfant*

Nous avons défini une attitude comme l'évaluation personnelle d'un individu envers un objet. Cette évaluation peut être basée sur des considérations affectives ou cognitives. Le profil attitudinal envers l'alimentation, tel que défini au paragraphe précédent, évalue dans quelle mesure une attitude implicite ou explicite sera basée sur des considérations liées au plaisir ou à la santé. Or, la prise en compte de l'un ou l'autre de ces critères peut donner lieu à une évaluation globale différente d'un aliment, car il ne sera pas évalué selon les mêmes critères, et donc à des choix alimentaires différents (**Figure 12**).

Nous faisons l'hypothèse que le profil attitudinal (i.e. la dominance relative implicite et/ou explicite du plaisir par rapport à la santé ou vice-versa) est susceptible de varier en fonction des enfants et serait à même de prédire des différences de choix alimentaires. En effet, la formation des attitudes dépend des expériences individuelles et la dominance affective ou cognitive des attitudes, de même que leur nature implicite ou explicite, influencent différemment les comportements. Etudier les différences interindividuelles de

profil attitudinal envers l'alimentation **(Articles 1, 2 et 3)** et leur lien avec les choix alimentaires **(Article 4)** devrait permettre de mieux comprendre les mécanismes psychologiques sous-jacents des comportements de choix alimentaires chez l'enfant.

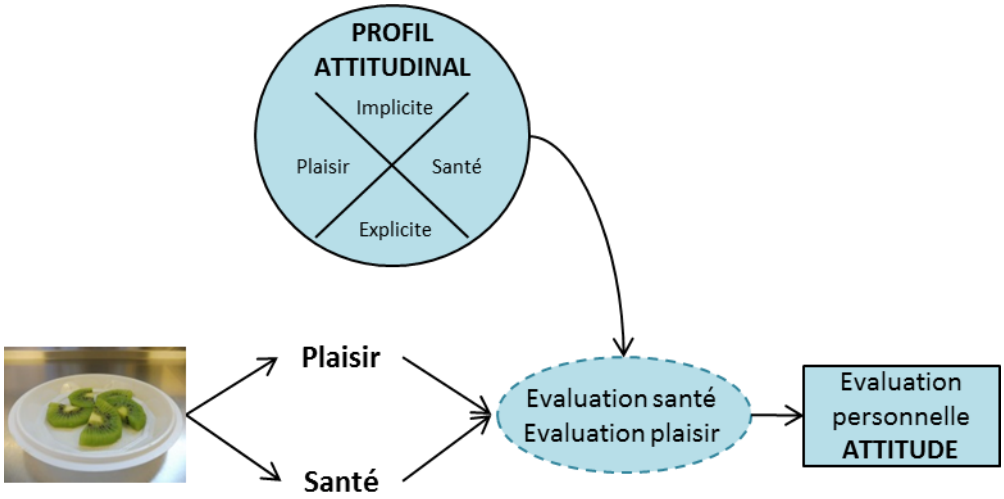


**Figure 12.** Influence du profil attitudinal sur l'évaluation d'un aliment selon les valeurs santé et plaisir

## 4. Contextes et choix alimentaires

### 4.1. Les facteurs contextuels qui influencent les comportements alimentaires : de l'environnement alimentaire à la situation de consommation

Dès l'origine de l'étude du comportement du consommateur, l'approche dominante est comportementaliste : elle prend en compte seulement des facteurs contextuels qui aboutissent à des réponses comportementales de choix en magasin, de marque ou de produit (Kotler, 1965). Concernant les comportements alimentaires, les modèles prédictifs incluent généralement des facteurs contextuels (voir paragraphe 2. de cette introduction), sans pour autant qu'il existe un consensus quant à leur définition et à leur classification. Par exemple, Dussart (1983) distingue trois catégories de stimuli liés au contexte et pouvant influencer les comportements alimentaires : les stimuli commerciaux, issus de l'environnement marketing du consommateur ; les stimuli socio-culturels issus de la culture, des groupes de référence et des réseaux relationnels de l'individu ; les stimuli circonstanciels résultant de la situation de consommation. Dans le modèle de Steenkamp (1993) apparaissent trois types de facteurs contextuels : les facteurs socioculturels, économiques et le marketing. Dans son travail de

thèse sur la modulation de l'expérience alimentaire par le contexte, C. Sester (2013) distingue les variables contextuelles non-reliées à l'aliment (e.g., lieu, ambiance, etc.) de celles qui lui sont reliées (e.g., contenant, packaging, etc.). D'autres auteurs ont proposé de distinguer les facteurs contextuels « simultanés », c'est-à-dire concomitants à la consommation, des facteurs contextuels « temporels », c'est-à-dire séparés dans le temps par rapport à la consommation (Bell & Meiselman, 1995; Rozin & Tuorila, 1993). Sijtsema et al. (2002) ont quant à eux distingué l'influence des facteurs contextuels liés à l'environnement alimentaire global ou liés précisément à la situation de consommation dans leur modèle de perception des aliments (**Figure 13**).

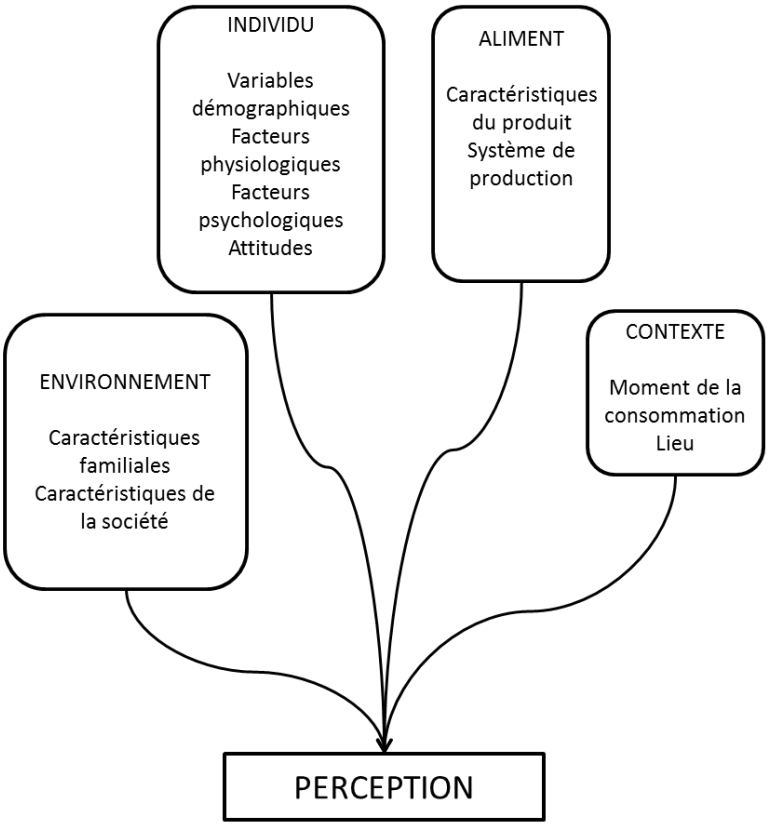


**Figure 13.** Modèle de la perception des aliments. (D'après Sijtsema et al., 2002)

Finalement, on retiendra deux dimensions inspirées de Larson & Story (2009) pour classer les facteurs contextuels influençant les comportements alimentaires :

(1) leur *champ* :

- les facteurs contextuels peuvent être propres à une *situation* précise de consommation, par exemple avec qui nous mangeons, dans quel lieu, quels sont les aliments disponibles ; cela regroupe tous les facteurs externes à

l'individu, présents dans son environnement proximal lors de l'acte alimentaire et à même d'influencer son comportement ;

- les facteurs contextuels peuvent être attachés à un *macro-environnement* alimentaire, par exemple les normes sociales et culturelles ou le marketing alimentaire ; ces facteurs ne sont pas liés à une situation alimentaire précise mais appartiennent à l'environnement alimentaire global des individus et sont susceptibles d'influencer leur comportement ;

(2) leur *nature* :

- les facteurs contextuels peuvent être liés à l'environnement *social* de l'acte alimentaire, par exemple les personnes avec qui l'on mange ou les normes liées à l'acte alimentaire dans un groupe social donné ;
- les facteurs contextuels peuvent être liés à l'environnement *physique* de l'acte alimentaire, par exemple l'offre alimentaire ou l'ambiance d'une situation précise, mais aussi plus généralement le marketing alimentaire ou l'offre alimentaire du quartier d'habitation.

Le **Tableau 1** précise cette classification par des exemples de facteurs contextuels appartenant à chaque catégorie au croisement des deux dimensions définies ci-dessus.

**Tableau 1.** Classification des facteurs contextuels influençant les comportements alimentaires. (D'après Larson & Story, 2009)

| ***Nature*** / ***Champs*** | **Facteurs sociaux** | **Facteurs physiques** |
|---|---|---|
| **Situation** | - Interaction avec la famille<br>- Interaction avec les pairs<br>- Mimétisme comportemental | - Lieu : type, ambiance, décor<br>- Moment : heure, jour, saison<br>- Aliments disponibles |
| **Macro-environnement** | - Normes sociales et culturelles<br>- Classe socio-professionnelle<br>- Valeurs | - Marketing alimentaire<br>- Politique agricole et alimentaire<br>- Revenu |

Les situations rencontrées s'inscrivent dans un macro-environnement, et nous verrons dans les paragraphes suivants que l'influence des facteurs contextuels situationnels s'expliquent par des mécanismes qui impliquent le macro-environnement alimentaire (e.g., normes sociales, marketing).

### 4.2. Influence des facteurs contextuels sur les comportements alimentaires

### *4.2.1. Facteurs contextuels sociaux et comportements alimentaires*

#### 4.2.1.1. Mécanismes de l'influence des facteurs contextuels sociaux sur les comportements alimentaires

Les choix alimentaires sont influencés par de nombreux facteurs qui interagissent entre eux. La culture dans laquelle les individus naissent et grandissent, mais aussi leurs interactions sociales, influencent de manière majeure leurs comportements alimentaires (Shepherd, 1999). Partager un repas avec des amis, de la famille ou des collègues est un évènement récurrent dans la vie de tous les jours (Oh, Erinosho, Dunton, Perna, & Berrigan, 2014). Le fait de manger est donc souvent associé à un contexte social, et ceux avec qui nous mangeons influencent à la fois ce que nous mangeons et combien nous mangeons (Herman, Roth, & Polivy, 2003). En effet, prendre son repas avec quelqu'un qui consomme de grandes quantités de nourriture peut amener à manger des quantités plus importantes que lorsqu'on est seul (Cruwys, Bevelander, & Hermans, 2015). De plus, il a été mis en évidence que manger en groupe augmente les quantités consommées par rapport à un repas pris tout seul (de Castro & Brewer, 1992). Ce phénomène de « modelage » de notre propre prise alimentaire sur celle des autres est très stable, comme en atteste une récente méta-analyse (Vartanian, Spanos, Herman, & Polivy, 2015).

L'un des mécanismes sous-jacent à cet effet de modelage des comportements alimentaires dans un contexte social est l'influence des normes sociales (Higgs, 2015). Les normes sociales sont des codes de conduites partagés par un groupe social (e.g., une culture, une famille, un groupe d'amis) et qui constituent un guide des comportements appropriés dans telle ou telle situation (Higgs, 2015). Ainsi, le modelage alimentaire pourrait s'expliquer par le fait que l'on considère le comportement alimentaire d'autrui comme la norme dans une situation donnée. On reproduit alors ce comportement qui est perçu comme le plus approprié à cette situation de consommation alimentaire (Herman et al., 2003). Néanmoins, ces normes sociales ne sont pas seulement communiquées par le comportement d'autrui, mais aussi par des pratiques culturelles, comme par exemple le fait de manger ou ne pas manger d'insectes (Looy, Dunkel, & Wood, 2013), ou des facteurs environnementaux physiques, par exemple laisser des papiers vides à côté d'un bocal de bonbons indique que d'autres personnes en ont mangé, ce qui incite les visiteurs suivants à en consommer davantage (Prinsen, De Ridder, &

De Vet, 2013). Les croyances à propos du comportement alimentaire d'autrui, c'est-à-dire les normes alimentaires perçues, influencent donc les comportements alimentaires des adultes (Pliner & Mann, 2004; Robinson, 2015).

Pourquoi suivons-nous ces normes sociales dans le domaine alimentaire ? A cette question, deux réponses ont été avancées : (1) pour renforcer notre appartenance à un groupe social – on imite d'autant plus une personne lorsque l'on appartient au même groupe social qu'elle (Stok, De Ridder, De Vet, & De Wit, 2014; Stok, Verkooijen, de Ridder, de Wit, & de Vet, 2014), et (2) parce que suivre une norme permet de choisir et de consommer les aliments de manière adéquate – si d'autres agissent de cette manière, cela doit être la bonne façon de faire (Deutsch & Gerard, 1955; Vartanian, Sokol, Herman, & Polivy, 2013). Higgs & Thomas (2016) ont modélisé l'influence des normes sociales sur les choix et la consommation alimentaire (**Figure 14**). Selon les auteurs, les normes concernant une situation alimentaire sont rendues saillantes au travers du comportement alimentaire d'autrui, des attentes partagées par un groupe, et de facteurs physiques, comme la taille des portions qui reflète une norme quant à la quantité qu'il est approprié de consommer. Le mangeur évalue alors la pertinence de la norme pour lui au travers d'une comparaison sociale avec le référent de la norme : similarité, force de l'identification. Si la norme est jugée pertinente par le mangeur, alors il peut se plier à cette norme en adoptant le comportement alimentaire adéquat. De plus, cette conformation à la norme dépend aussi de traits tempéramentaux et d'autres facteurs contextuels, par exemple l'attention portée à la norme ou l'intérêt pour le mangeur d'agir de manière socialement appropriée. L'ajustement du comportement alimentaire pour se conformer à une norme peut impliquer sa synchronisation à celui des autres, un contrôle de la consommation et des changements en termes d'évaluation des aliments. Enfin, les auteurs considèrent que se conformer à une norme renforce celle-ci (Higgs & Thomas, 2016).

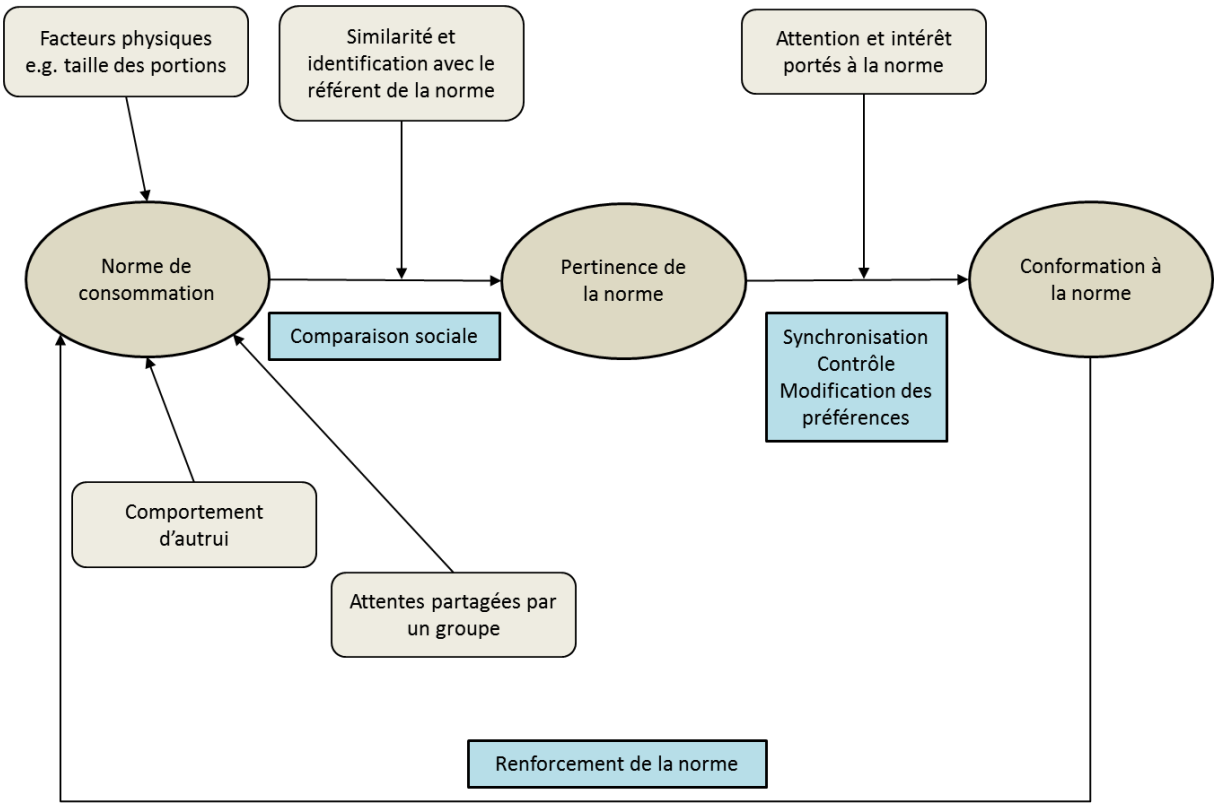


**Figure 14.** Modèle de l'influence des normes sociales sur le comportement alimentaire. (D'après Higgs & Thomas, 2016)

Il n'est pas clairement établi si les individus sont conscients ou non de ces influences sociales sur leurs comportements, notamment alimentaires. Certaines études expérimentales tendent à montrer que bien que les participants aient été effectivement influencés par les comportements alimentaires d'autres mangeurs, ou par l'information qu'ils avaient reçue à propos de ce que d'autres mangeurs avaient consommé, ils ne reportaient pas, ou ne reconnaissaient pas, une telle influence sur leur propre comportement (Spanos, Vartanian, Herman, & Polivy, 2013; Vartanian, Herman, & Wansink, 2008). Néanmoins, des études qualitatives explorant les croyances des consommateurs envers les comportements alimentaires ont mis en évidence que les adultes et les adolescents déclaraient que le contexte social de la prise alimentaire, ainsi que le comportement des autres convives, pouvaient influencer leur propre comportement alimentaire (Brug, Lechner, & De Vries, 1995; Cullen, Baranowski, Rittenberry, & Olvera, 2000). Récemment, Robinson & Field (2015) ont conduit une étude expérimentale au cours de laquelle les participants étaient exposés à une information à propos des quantités de biscuits consommées par d'autres personnes (8-10 ou 1-2 biscuits) avant qu'on ne leur serve les mêmes biscuits qu'ils pouvaient alors consommer à volonté. Ils ont montré que les participants qui reportaient avoir été influencés par le message,

avaient effectivement ajusté leur consommation en fonction du message reçu. Au contraire, les participants qui reportaient ne pas avoir été influencés par le message, n'avaient pas ajusté leur consommation. Selon les auteurs, il semble donc probable que les individus soient conscients des influences sociales sur leur comportement alimentaire. Cette conclusion peut être nuancée par le fait que les normes sociales étaient rendues très explicites par les conditions expérimentales de cette étude (i.e., avant de manger les biscuits, l'attention des participants était délibérément focalisée sur les quantités de biscuits consommées par d'autres). On peut se demander ce qu'il en est dans la vie quotidienne lorsque nous prenons un repas à plusieurs sans forcément prêter attention à ce que les autres mangent. Sommes-nous influencés socialement dans ce cas ? Si oui, en sommes-nous conscients ? D'autres recherches seraient nécessaires pour investiguer ce point.

#### 4.2.1.2. Influence des facteurs contextuels sociaux sur les comportements alimentaires des enfants

Chez l'enfant, il a été mis en évidence que le contexte social pouvait influencer l'acceptation d'un nouvel aliment, les choix alimentaires et les quantités consommées (Addessi, Galloway, Visalberghi, & Birch, 2005; Frazier, Gelman, Kaciroti, Russell, & Lumeng, 2012; Lumeng & Hillman, 2007; Lumeng, Patil, & Blass, 2007). Déjà chez le nouveau-né de 7 à 14 semaines, il a été montré que la consommation de lait infantile augmentait lorsque la personne nourrissant l'enfant à l'aide d'un biberon interagissait avec lui en lui parlant, en le touchant et en le regardant dans les yeux (Lumeng et al., 2007). De plus, des phénomènes de modelage social dans le domaine alimentaire ont été observé chez l'enfant dès l'âge de 1 an (Harper & Sanders, 1975), et ce phénomène reste stable au cours du développement (revue de la literature : Cruwys, Bevelander, & Hermans, 2015). En effet, lorsque des adultes présentaient des aliments inconnus à des enfants âgés respectivement de 14-20 mois ou 42-48 mois, les enfants acceptaient plus fréquemment de goûter le nouvel aliment lorsque l'adulte le mangeait aussi que lorsque celui-ci leur proposait simplement l'aliment (Harper & Sanders, 1975). De même, les enfants de 2 à 5 ans sont plus enclins à accepter un nouvel aliment lorsque des adultes consomment devant eux le même type d'aliment (e.g., un aliment de la même couleur) (Addessi et al., 2005). De plus, il a été montré que les comportements alimentaires de leurs pairs avaient encore plus d'influence que ceux des adultes sur les choix alimentaires des enfants (Frazier et al., 2012), et sur l'acceptation d'un nouvel aliment (Hendy & Raudenbush, 2000). Il a aussi été montré que des enfants de 2

à 6 ans consommaient plus de pizza en un temps déterminé lorsqu'ils étaient en groupe de neuf que lorsqu'ils étaient en groupe de trois (Lumeng & Hillman, 2007).

Si l'influence du contexte social sur le comportement alimentaire de l'enfant est largement étayée, ce n'est que récemment que des scientifiques se sont intéressés aux mécanismes sous-jacents à ce phénomène, et notamment à l'influence des normes sociales en termes d'alimentation dans l'enfance. Sharps et Robinson (2015) ont imaginé une étude au cours de laquelle des enfants de 6 à 11 ans devaient effectuer un jeu et avaient l'opportunité de consommer des carottes disposées dans un bol pendant que l'expérimentateur installait le jeu. La consommation de carottes n'était donc pas présentée comme le but principal de l'expérience. Avant de proposer les carottes aux enfants, ceux-ci étaient exposés à des normes de consommation via des indices disposés dans la salle d'expérimentation (e.g., relevés de consommation des enfants ayant déjà participé, bols de carottes vides ou pleins) qui laissaient supposer que les enfants de la session précédente avaient mangé respectivement toutes les carottes proposées lors de la session expérimentale ou aucune carotte. Ils ont observé que les enfants étaient influencés par la norme alimentaire perçue : ils mangeaient significativement plus de carottes lorsqu'ils pensaient que les participants de la session précédente en avaient eux-mêmes mangé beaucoup, que lorsqu'ils pensaient que les participants précédents n'en avaient pas consommé. Les enfants de 6 à 11 ans sont donc influencés par les normes alimentaires qu'ils perçoivent dans leur environnement. Dans une seconde étude, les mêmes auteurs se sont intéressés aux mécanismes sous-jacents au respect de ces normes alimentaires par les enfants (Sharps & Robinson, 2017). Ils ont mis en évidence que les enfants adaptaient d'autant plus les quantités qu'ils consommaient à la norme de consommation perçue, lorsqu'ils se trouvaient dans un contexte alimentaire qui ne leur était pas familier. Les auteurs suggèrent que les enfants utilisent la norme alimentaire perçue comme un guide pour adopter le comportement alimentaire adéquat à une nouvelle situation.

Les comportements alimentaires des enfants sont donc à même d'être influencés par le contexte social de la consommation alimentaire. Les enfants s'inspirent du comportement d'autrui pour adopter le comportement alimentaire le plus approprié. Ce modelage des comportements alimentaires de la part des enfants s'inscrit dans un processus d'apprentissage des comportements alimentaires culturellement adéquats dans telle ou telle situation sociale (Birch, Savage, & Ventura, 2007; Birch & Fisher, 1998).

#### 4.2.1.3. Facteurs contextuels sociaux et obésité

Les normes sociales relatives à l'alimentation pour un individu sont dépendantes du groupe social dans lequel il évolue (Higgs, 2015). Il a été mis en évidence que le régime alimentaire des individus était corrélé à celui des personnes qui leur étaient socialement reliées (e.g., famille, amis) ; chez les adultes (Barclay, Edling, & Rydgren, 2013; Pachucki, Jacques, & Christakis, 2011; Pelletier, Graham, & Laska, 2014) et chez les adolescents (De la Haye, Robins, Mohr, & Wilson, 2013; Pedersen, Grønhøj, & Thøgersen, 2015; Stok, de Vet, et al., 2015). De plus, on retrouve par l'étude des relations sociales, l'existence de groupe de personnes reliées entre elles socialement et de même statut pondéral (Christakis & Fowler, 2007). On peut alors se demander dans quelle mesure des normes sociales alimentaires partagées au sein d'un réseau social, qui promouvraient par exemple une surconsommation, pourraient être associées à l'obésité (Higgs & Thomas, 2016). En effet, au sein de certains groupes sociaux, il peut être plus ou moins acceptable de manger de grandes quantités, de grignoter, ou bien de consommer fréquemment des aliments denses énergétiquement (e.g., gras et sucrés). A notre connaissance, aucune étude à ce jour ne répond à cette question, que ce soit chez l'adulte ou l'enfant. Or, nous avons vu que l'enfant était perméable très tôt aux normes sociales concernant son alimentation. Un point de départ, que nous proposons lors du travail expérimental de cette thèse, est d'étudier l'influence de différents contextes alimentaires sociaux sur les choix alimentaires des enfants normo-pondéraux et en surpoids.

### *4.2.2. Facteurs contextuels physiques et comportements alimentaires*

#### 4.2.2.1. Mécanismes de l'influence des facteurs contextuels physiques sur les comportements alimentaires

Tous les modèles de prédiction des comportements alimentaires incluent des facteurs contextuels liés à l'environnement physique et notamment alimentaire (Shepherd, 1990; Sijtsema et al., 2002). L'influence de l'environnement sur les comportements alimentaires des individus est considérée comme majeure, si bien que le contexte alimentaire des sociétés occidentales est tenu pour responsable de l'épidémie d'obésité actuelle par de nombreux auteurs (Booth et al., 2005; Stok, Vet, et al., 2015; Swinburn et al., 1999). En effet, s'il a longtemps été considéré que les individus étaient totalement responsables de leurs choix et conscients de ce qui pouvait les influencer, cette assertion est remise en question depuis que des études en psychologie et neurosciences ont mis en évidence des processus non-conscients influençant la prise de décision (Bargh & Chartrand, 1999; Bargh & Ferguson, 2000;

Dijksterhuis, Bos, Nordgren, Baaren, & Brava, 2006; Greenwald & Banaji, 1995). Les décisions alimentaires n'y échappent pas. Wansink & Sobal (2007) estiment qu'un individu prend plus de 200 décisions alimentaires dans une journée. Les auteurs ajoutent que, dans la majorité des cas, nous ne sommes pas capables de reporter la manière dont l'environnement a influencé nos décisions alimentaires, ou nous ne reconnaissons cette influence. Ainsi, bien qu'encore largement répandue, la vision selon laquelle une personne serait en surpoids ou obèse « par sa faute », suite aux conséquences de choix alimentaires effectués de manière tout à fait délibérée et consciente, hors de toute influence de l'environnement notamment physique, est remise en question.

Cohen & Babey (2012) identifient trois mécanismes par lesquels les facteurs contextuels physiques influencent la prise de décision alimentaire : le conditionnement, l'effet d'exposition et l'amorçage. Dans les paragraphes suivants nous développons ces trois mécanismes, en particulier l'amorçage car nous utiliserons ce paradigme (i.e., amorçage olfactif) dans le travail expérimental de cette thèse.

Le *conditionnement* est l'appariement récurrent de deux stimuli qui deviennent alors associés en mémoire. De cet appariement résulte que les caractéristiques ou les qualités de l'un puissent être transférées à l'autre (Brunstrom, 2007). Cohen & Bahey (2012) avancent que les préférences pour les produits marketés sont un exemple de conditionnement qui influence les choix alimentaires. Par exemple, l'utilisation d'un personnage de dessin animé sur l'emballage d'un aliment, transfère l'attirance ou la sympathie que l'enfant peut avoir pour ce personnage à l'aliment lui-même (Roberto, Baik, Harris, & Brownell, 2010; Schor & Ford, 2007).

L'*effet d'exposition (simple ou répétée)* se manifeste lorsqu'un individu est exposé à un stimulus dans son environnement, sans qu'il ne soit apparié à aucun autre stimulus. Être exposé à un objet de manière répétée augmente l'attirance pour cet objet comparé à des objets qui n'ont jamais été vus précédemment (Zajonc, 2001). En effet, via cette exposition, et même si l'individu ne s'en rappelle pas consciemment, l'objet est considéré comme faisant partie de son environnement familier, et donc perçu comme sans danger. Cet effet d'exposition est le mécanisme expliquant l'efficacité du « placement de produit ». Par exemple, quand un produit est vu une première fois dans un film, adultes (Law & Braun, 2000) et enfants (Auty & Lewis, 2004) sont plus enclins à choisir ce produit ultérieurement.

Un effet d'*amorçage* a lieu lorsqu'un stimulus (e.g., visuel, olfactif, auditif) influence le comportement d'un individu via l'activation non-consciente des concepts qui lui sont associés en mémoire. En effet, selon le « modèle à diffusion d'activation » de la mémoire présenté au paragraphe 3. (Collins & Loftus, 1975), les comportements associés aux concepts activés par le stimulus sont alors facilités, et cela même si le stimulus n'est pas attentivement perçu, c'est-à-dire même si l'individu n'est pas capable de reporter sa présence dans l'environnement. Un effet d'amorçage se produit lorsqu'un individu n'a pas conscience soit du stimulus lui-même, soit de l'effet potentiel du stimulus sur son comportement ; si l'individu est conscient qu'une influence s'exerce sur lui, alors il peut compenser cette influence (Bargh, 2006). Dans le domaine alimentaire, des études récentes ont mis en évidence ce phénomène d'amorçage avec des stimuli visuels (Anschutz, van Strien, & Engels, 2008; Fishbach, Friedman, & Kruglanski, 2003; Harris, Bargh, & Brownell, 2009; Ouwehand & Papies, 2010; Papies, Stroebe, & Aarts, 2008, 2009; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008) et olfactifs (Chambaron, Chisin, Chabanet, Issanchou, & Brand, 2015; Coelho, Polivy, Herman, & Pliner, 2009; Fedoroff, Polivy, & Herman, 1997; Fedoroff, Polivy, & Peter Herman, 2003; Gaillet-Torrent, Sulmont-Rossé, Issanchou, Chabanet, & Chambaron, 2014; Gaillet, Sulmont-Rossé, Issanchou, Chabanet, & Chambaron, 2013). Par exemple, Fishbach et al. (2003) ont assigné des jeunes femmes préoccupées par leur poids soit à une condition d'amorçage du concept de « régime amaigrissant », soit à une condition contrôle. Dans la condition d'amorçage du « régime amaigrissant », les participantes patientaient dans une pièce leur proposant différents magazines sur la nutrition, l'activité physique ou les régimes. Dans la condition contrôle, les participantes pouvaient feuilleter des magazines traitant de l'économie ou de la géographie des Etats-Unis. Ensuite, les participantes des deux conditions effectuaient une tâche de décision lexicale (i.e., des chaînes de caractères apparaissent à l'écran d'un ordinateur et le sujet doit déterminer le plus vite possible s'il s'agit ou pas d'un mot ; pour cela il clique sur des touches déterminées du clavier d'un ordinateur et les temps de réaction sont mesurés) puis devaient choisir comme encas un Twix® ou une pomme. Les résultats ont montré que les participantes dans la condition d'amorçage du « régime » présentaient des temps de réaction plus courts lors de la tâche de décision lexicale pour le mot « régime », suggérant l'activation du concept de « régime » par les magazines. Ces participantes choisissaient aussi plus fréquemment des pommes en guise d'encas que celles de la condition contrôle. Concernant l'amorçage olfactif, Gaillet et al. (2013) ont mis en évidence que des adultes non-attentivement exposés à une odeur de melon, comparés à des adultes exposés à aucune odeur, étaient d'une part plus rapides à identifier le

mot « melon » comme un mot lors d'une tâche de décision lexicale, d'autre part choisissaient plus d'entrées à base de légumes lors d'une tâche d'intention de choix alimentaires sur un menu. Ces résultats suggèrent que le concept de « melon » a été activé chez les participants exposés à cette odeur sans qu'ils ne s'en rendent compte. Cette activation aurait facilité le traitement du mot « melon » lors de la tâche de décision lexicale et orienté les intentions de choix alimentaires vers des aliments congruents, i.e. des légumes en entrée. De plus, Gaillet et al. (2014) ont montré que des adultes exposés non-attentivement à une odeur de poire, comparés à des adultes exposés à aucune odeur, choisissaient significativement plus de desserts à base de fruits lors d'un repas suivant l'exposition à l'odeur. Ces résultats mettent en évidence une facilitation du choix de fruits suite à l'exposition non-attentive à une odeur de poire ; cette facilitation serait due à l'activation implicite du concept « poire » par l'odeur de poire, et consécutivement, selon le « modèle à diffusion d'activation » de la mémoire, du concept associé « fruit ».

L'influence des facteurs contextuels physiques sur les comportements alimentaires, notamment celle des facteurs directement liés à l'environnement alimentaire (e.g., images ou odeurs d'aliments, emballages), a lieu en grande partie à l'insu des individus. Dès l'enfance, ces mécanismes non-conscients peuvent avoir un impact sur les comportements alimentaires. C'est ce que nous allons détailler au paragraphe suivant.

#### 4.2.2.2. Influence des facteurs contextuels physiques sur les choix alimentaires des enfants

L'environnement alimentaire des enfants est déterminé par les lieux et les personnes qu'ils fréquentent, comme leurs parents à la maison ou le personnel de la cantine à l'école, mais aussi de manière plus macroscopique par le milieu culturel dans lequel ils évoluent, incluant leur exposition au marketing des produits alimentaires, ou bien aux politiques publiques en termes d'alimentation mises en place dans leur pays, leur région ou leur commune. Au cours des dernières décennies, l'influence des pratiques parentales et du marketing sur les comportements alimentaires des enfants a été étudiée de manière approfondie (revues de la litérature : Savage, Fisher, & Birch, 2007; Story & French, 2004; Strasburger, 2006).

Comme nous l'avons vu au paragraphe précédent, les effets des facteurs contextuels sur les comportements alimentaires dépendent des expériences propres à chacun, notamment

des expositions passées aux stimuli alimentaires et des concepts associés entre eux en mémoire. Dans l'enfance, ces expositions sont en grande partie conditionnées par les pratiques parentales. Le sujet n'est pas ici de faire une revue exhaustive de l'influence des pratiques parentales sur le comportement alimentaire des enfants (revue de la litérature : Savage et al., 2007), mais de mettre en évidence le fait que les parents (ou plus généralement les personnes en charge de l'alimentation de l'enfant), en décidant de l'offre alimentaire proposée, construisent la mémoire alimentaire de l'enfant qui renforcera l'influence de tel ou tel facteur contextuel sur son comportement alimentaire ultérieur. Par exemple, il est bien connu que l'exposition répétée à un aliment, initialement non-apprécié, augmente son acceptation par l'enfant (Birch, Gunder, Grimm-Thomas, & Laing, 1998; Maier, Chabanet, Schaal, Issanchou, & Leathwood, 2007; Remy, Issanchou, Chabanet, & Nicklaus, 2013). De plus, présenter ensemble deux aliments à un enfant, l'un apprécié, l'autre non, augmente son acceptation de l'aliment initialement non-apprécié (Keller, 2014). Ces phénomènes sont dus aux effets d'exposition et de conditionnement présentés au paragraphe précédent. Si l'on s'intéresse maintenant à l'amorçage, comme l'explique Gaillet et al. (2013), un effet d'amorçage ne peut avoir lieu que si des concepts sont déjà présents dans la mémoire des individus et associés à l'amorce (i.e., au stimulus) de manière assez forte pour être activés lorsque le stimulus est rencontré. C'est pourquoi l'environnement alimentaire global d'un enfant, passé et présent, influence son comportement alimentaire.

Le lien entre marketing, publicité et comportement alimentaire des enfants a été largement étudié (Friant-Perrot & Garde, 2014; Garde et al., 2012; Story & French, 2004; Strasburger, 2006). De manière générale, il a été montré que les stratégies marketing et publicitaires pour les produits alimentaires influencent les comportements alimentaires des enfants. Nous donnons quelques exemple afin d'illustrer les mécanismes sous-jacents à cette influence. Par exemple, il a été montré que le fait de présenter un aliment avec un personnage de dessin animé sur l'emballage augmentait son appréciation et sa probabilité d'être choisi par des enfants de 4 à 6 ans, comparé au même aliment mais présenté sans personnage de dessin animé (Roberto et al., 2010). Dans une autre étude, des enfants de 6-7 ans et de 11-12 ans devaient regarder la même scène du film *Home Alone* dans laquelle apparaissait soit du Pepsi Cola® consommé durant un repas, soit aucun produit de marque (Auty & Lewis, 2004). Les enfants devaient ensuite décrire la scène et, à la fin de l'expérience, il leur était proposé de choisir une boisson entre un Pepsi Cola® et un Coca Cola®. Les enfants ayant vu l'extrait comportant le Pepsi Cola® choisissaient significativement plus de Pepsi Cola® à la fin de

l'expérience que ceux ayant vu l'extrait sans produit de marque. Les auteurs suggèrent que le placement d'un produit déjà familier dans un film agit comme un « rappel » qui affecte ensuite le choix des enfants. Concernant l'effet des clips publicitaires, il a été montré que des enfants de 2 à 6 ans choisissaient plus le produit alimentaire dont ils venaient de visionner la publicité (incluse dans un programme pour enfant) versus un aliment comparable, par rapport à des enfants qui n'avaient pas été exposés à cette publicité (Borzekowski & Robinson, 2001). De plus, il a été mis en évidence à plusieurs reprises, chez l'enfant de 7 à 11 ans, que visionner des publicités pour des produits alimentaires augmentait les quantités d'aliments consommés pendant le visionnage et après, que ce soit des aliments inclus dans la publicité ou non (Halford, Gillespie, Brown, Pontin, & Dovey, 2004; Harris et al., 2009). Les auteurs suggèrent que l'exposition à des publicités alimentaires active le concept de consommation alimentaire, ceci ayant pour conséquence de faciliter la consommation et donc d'augmenter les quantités consommées.

On démontre ici que l'environnement alimentaire des enfants peut avoir une influence significative sur leurs comportements. Leur macro-environnement alimentaire, englobant l'offre alimentaire qui leur est proposée par leurs parents ou leur exposition à la publicité et au marketing alimentaire, façonne leur « mémoire alimentaire » qui influence à son tour leur réactivité face aux facteurs contextuels attachés à une situation donnée.

#### 4.2.2.3. Facteurs contextuels physiques et obésité

Comme mentionné au paragraphe 1. de cette introduction, il a été mis en évidence que les enfants en surpoids étaient plus suceptibles d'être influencés par leur environnement alimentaire que les enfants normo-pondéraux (Carnell, Benson, Pryor, & Driggin, 2013). Nous nous intéressons en particulier à l'influence des odeurs sur les comportements alimentaires des enfants normo-pondéraux et en surpoids, car nous avons mis en place un paradigme d'amorçage olfactif dans la partie expérimentale de cette thèse.

Jansen et al. (2003) ont proposé à des enfants normo-pondéraux et en surpoids de consommer à volonté des aliments palatables (i.e., M&M's®, cacahuètes caramélisées, morceaux de gâteaux, Milky Way®, chips et graines grillées et salées) et ont relevé les quantités consommés par les enfants. Les enfants ont répété cette expérience deux fois, à une semaine d'intervalle, dans deux conditions : (1) une condition contrôle, dans laquelle ils jouaient aux legos avant de manger, (2) une condition d'exposition à l'odeur des aliments où

il leur était demandé de sentir les aliments pendant 10 min avant de les manger. Les résultats sont présentés **Figure 15**. On observe que chez les enfants en surpoids la consommation augmente lorsqu'ils sont exposés à l'odeur des aliments, alors que chez les enfants normo-pondéraux elle diminue. Les auteurs avancent que le fait de sentir les aliments avant de les manger auraient eu un effet d'amorçage de leur consommation chez les enfants en surpoids. Au contraire, chez les enfants normo-pondéraux, les auteurs avancent que l'odeur de ces aliments aurait participé à un rassasiement sensoriel spécifique plus précoce[3], conduisant à une moindre consommation de ces mêmes aliments (Rolls & Rolls, 1997).

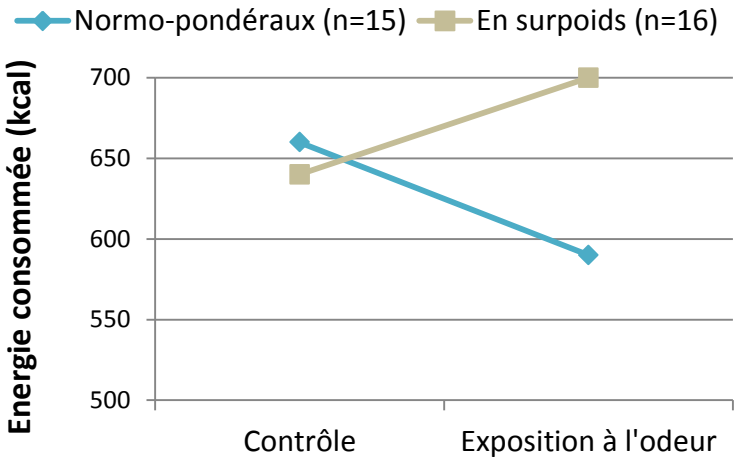


**Figure 15.** Energie consommée par les enfants normo-pondéraux et en surpoids suite à l'exposition ou non à l'odeur des aliments à consommer. (D'après Jansen et al., 2003)

Dans une étude de Soussignan et al. (2012), on demandait à des enfants normo-pondéraux et en surpoids de sentir des odeurs d'aliments soit de densité énergétique élevée (i.e., steak, bacon, pizza, et chocolat), soit de densité énergétique faible (i.e., poireau, chou-fleur, orange, et fraise), soit des odeurs non alimentaires (i.e., lavande, rose, savon, et herbe) pendant quatre secondes chacune. Les expérimentateurs ont ensuite relevé l'occurrence de léchage des lèvres pendant 10 secondes après l'exposition à chaque odeur pour chaque participant. Les résultats sont présentés **Figure 16**. On observe que les enfants en surpoids se lèchaient plus les lèvres que les enfants normo-pondéraux après avoir senti les odeurs alimentaires de densité énergétique élevée ou faibble. Les auteurs supposent que la fréquence de léchage des lèvres est un indicateur de l'appréciation anticipée des aliments. Ces résultats

[3] Le rassasiement sensoriel spécifique est définit comme la diminution du plaisir ressenti au cours de la consommation d'un aliment. Cette réduction du plaisir est spécifique à un aliment, c'est une forme d'habituation c'est-à-dire une diminution de la réponse comportementale quand la cause qui a déclenché le comportement demeure. Rolls & Rolls (1997) ont montré que ce rassasiement sensoriel spécifique pouvait être déclenché par l'olfaction.

suggèrent donc que les enfants en surpoids anticiperaient plus de plaisir dérivant de la consommation alimentaire lorsqu'ils sont exposés à des odeurs par rapport aux enfants normo-pondéraux.

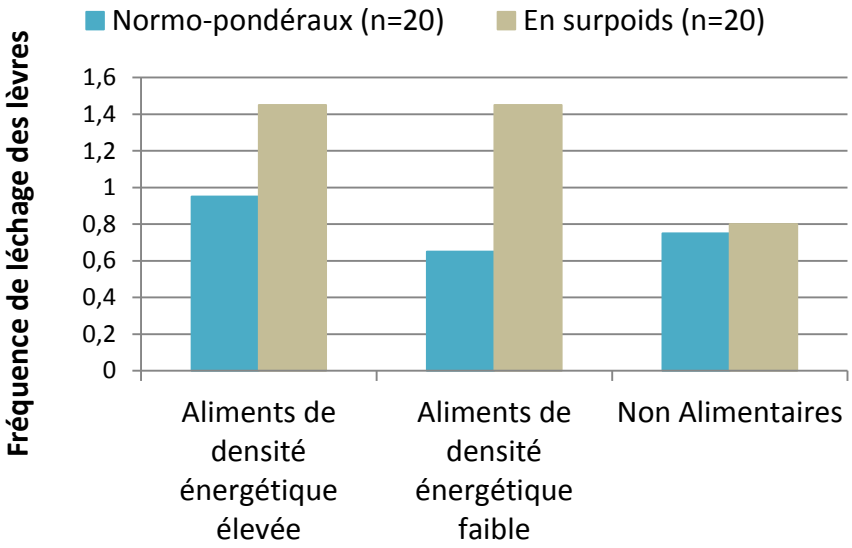


**Figure 16.** Fréquence de léchage des lèvres des enfants normo-pondéraux et en surpoids durent l'exposition à des odeurs alimentaires ou non alimentaires. (D'après Soussignan et al., 2012)

Ces deux études mettent en évidence que les enfants en surpoids réagissent différemment aux odeurs d'aliments par rapport aux enfants normo-pondéraux. Néanmoins, ces études ne reportent pas dans quelle mesure les participants étaient conscients ou non du lien potentiel entre les odeurs et leurs comportements subséquents. Le paradigme d'amorçage est construit de sorte que les sujets ne fassent pas consciement le lien entre l'exposition à un stimulus (i.e., l'amorce) et leur comportement. En utilisant ce paradigme, il serait intéressant de comparer l'influence d'odeurs non-attentivement perçues sur les comportements alimentaires d'enfants normo-pondéraux et en surpoids.

## 4.3. Construire des contextes alimentaires santé/plaisir adaptés à l'enfant

### *4.3.1. Définition des contextes santé/plaisir*

Ce travail de thèse porte en particulier sur l'influence du plaisir et de la santé sur les choix alimentaires des enfants. Nous avons décrit ci-dessus que le contexte de consommation, via ses facteurs sociaux et physiques, influence les comportements alimentaires des enfants.

Or, certaines situations peuvent mobiliser plus ou moins des considérations liées au plaisir et à la santé. Nous suggérons que via la manipulation de facteurs sociaux (e.g., les invités d'un goûter d'anniversaire *versus* les camarades de classe lors d'une intervention nutritionnelle) et physiques (e.g., des odeurs d'aliments gras-sucrés versus des odeurs de fruits) nous puissions construire des situations alimentaires stimulant des représentations liées au plaisir ou à la santé afin d'étudier l'influence respective de ces deux concepts sur les choix alimentaires des enfants. La **Figure 17** illustre la construction de ces contextes santé/plaisir.

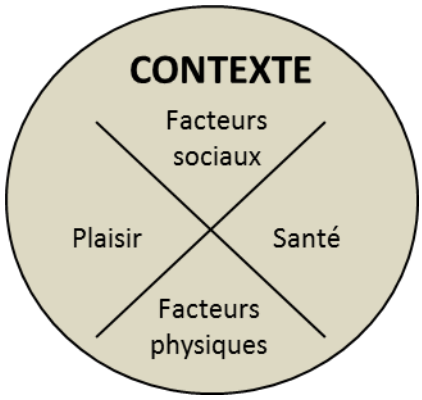


**Figure 17.** Les composantes des contextes santé/plaisir

*4.3.2. Liens potentiels entre contextes santé/plaisir et choix alimentaires chez l'enfant*

Au paragraphe 2. de cette introduction nous avons présenté le processus de la prise de décision alimentaire comme une comparaison de l'évaluation des différentes options d'aliments via une pondération de différents attributs, parmi lesquels les valeurs plaisir et santé (Rangel, 2013). Comme cela a déjà été suggéré chez l'adulte (Connors et al., 2001), nous faisons l'hypothèse que le poids des différents critères dans les choix alimentaires des enfants, et notamment du plaisir et de la santé, pourrait dépendre du contexte de consommation. Or, la prise en compte de l'un ou l'autre de ces critères pourrait donner lieu à une évaluation différente de chaque aliment et donc à des choix alimentaires différents (**Figure 18**).

De plus, nous nous intéresserons à l'influence de ces contextes sur les choix alimentaires des enfants normo-pondéraux et en surpoids. En effet, de nombreuses études ont mis en évidence des différences entre les enfants normo-pondéraux et en surpoids quant à leur sensibilité aux signaux de l'environnement alimentaire (Carnell et al., 2013; Jansen et al., 2003; Soussignan et al., 2012). Nous souhaitons donc comparer l'influence de contextes alimentaires évoquant le plaisir ou la santé sur les choix alimentaires d'enfants normo-

pondéraux et en surpoids, en manipulant soit l'environnement social **(Article 5)**, soit l'environnement physique **(Article 6)**. D'une part, nous comparerons les normes sociales attachées au plaisir ou à la santé lorsqu'il est question de choix alimentaires dans les deux groupes d'enfants dans différents contextes sociaux. D'autre part, nous comparerons l'influence de stimuli olfactifs non-attentivement perçus sur les choix alimentaires des deux groupes d'enfants.

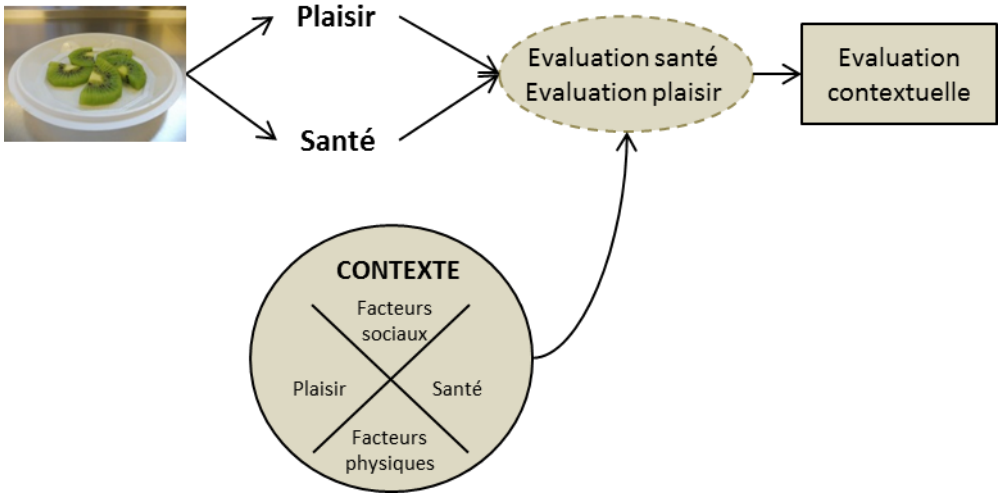


**Figure 18.** Influence des contextes sur l'évaluation d'un aliment selon les valeurs santé et plaisir

## 5. Les ambitions de la thèse

### 5.1. Objectifs

Ce travail de thèse répond à la fois à des objectifs théoriques et pratiques. D'un point de vue théorique, c'est la première fois que les attitudes envers l'alimentation sont mesurées dans toutes leurs dimensions (i.e., implicites, explicites, affectives, cognitives) chez l'enfant. Le fait d'étudier le lien entre ces attitudes et les comportements s'inscrit dans la dynamique actuelle de l'étude des attitudes dans le domaine de l'alimentation (e.g., König et al., 2016; Trendel & Werle, 2016) et apporte de nouvelles connaissances quant à l'interaction des attitudes implicites et explicites dans la prédiction des comportements alimentaires. De plus, comparer l'influence du contexte social sur les choix alimentaires des enfants normo-pondéraux et en surpoids, ainsi que leur sensibilité à des stimuli olfactifs non-attentivement perçus, sont des questions qui n'ont jamais été explorées. Les travaux de cette thèse

enrichiront donc la compréhension des mécanismes psychologiques associés à l'obésité dès l'enfance, en particulier en relation avec l'environnement alimentaire.

Dans un contexte de forte prévalence du surpoids et obésité chez l'enfant, la stratégie dominante pour amener les enfants à faire des choix alimentaires de meilleure qualité nutritionnelle est d'améliorer leurs connaissances en nutrition et sur les conséquences de leur alimentation sur leur santé. Ces connaissances sont-elles des critères de choix alimentaires pour les enfants ? Est-ce que déclarer que la santé est une valeur importante amène les enfants à faire des choix plus sains ? Est-ce que considérer avant tout l'alimentation comme une source de plaisir est délétère pour la santé des enfants ? D'un point de vue pratique, explorer ces questions permettra de mieux cerner les processus de choix alimentaires chez les enfants et d'étayer des pistes de communication et d'intervention pour les guider vers les choix alimentaires les plus favorables à leur santé.

### 5.2. Problématique

Dans un contexte alimentaire où le plaisir et la santé sont souvent présentés comme antinomiques, cette thèse s'intéresse à leur impact respectif sur les choix alimentaires de l'enfant. En effet, les préférences des enfants ne coïncident pas avec les recommandations nutritionnelles : ils apprécient les aliments à haute densité énergétique, mais moins les fruits et les légumes (Cooke & Wardle, 2005; Adam Drewnowski, 2009; Gibson & Wardle, 2003; Nicklaus, Boggio, & Issanchou, 2005; Russell & Worsley, 2007). Le plaisir alimentaire est donc souvent considéré comme une menace dans une société où l'offre alimentaire est pléthorique et où il faudrait diminuer la consommation des aliments les plus énergétiques pour préserver la santé des enfants (Swinburn et al., 1999). Néanmoins, plaisir et santé ne sont pas toujours opposés dans la littérature, et certaines études interculturelles chez l'adulte avancent que le plaisir alimentaire pourrait être associé à une alimentation plus équilibrée avec des effets bénéfiques sur la santé (Rozin et al., 1999; Saulais et al., 2012). Cette thèse propose donc de démêler les effets des considérations liées au plaisir et à la santé sur le comportement de choix alimentaires des enfants normo-pondéraux et en surpoids âgés de 5 à 11 ans.

Le processus de choix alimentaire implique d'évaluer les différentes options proposées dans une situation de choix (Rangel, 2013). Pour cela, plusieurs attributs attachés aux aliments sont pondérés, de manière plus ou moins consciente, notamment les valeurs de plaisir et de santé (Fitzgerald et al., 2010), pour aboutir à une évaluation globale de chaque

aliment. Par ailleurs, les modèles de prédiction des choix alimentaires incluent systématiquement des variables individuelles et de l'environnement pour expliquer les choix alimentaires (Shepherd, 1990). En effet, en fonction de l'individu et du contexte, certains critères peuvent avoir plus ou moins de poids dans le choix (Connors et al., 2001). Dans ce manuscrit, nous nous intéressons uniquement aux critères de plaisir et de santé et à leur impact sur les choix alimentaires des enfants.

Afin d'étudier l'influence des valeurs plaisir et santé sur les choix alimentaires des enfants, nous avons caractérisé leur tendance individuelle à privilégier le plaisir ou la santé (i.e., leur profil attitudinal) et nous avons manipulé le contexte de choix afin qu'il évoque le plaisir ou la santé. L'hypothèse sous-jacente est que le profil attitudinal santé/plaisir, ainsi que le contexte santé/plaisir, influenceraient le poids respectif des critères santé et plaisir pour l'évaluation des aliments dans une situation de choix. La prise en compte de l'un ou l'autre de ces critères pouvant donner lieu à une évaluation globale différente d'un aliment, des profils attitudinaux différents ou bien des contextes différents, devraient donner lieu à des choix alimentaires différents (**Figure 19**)

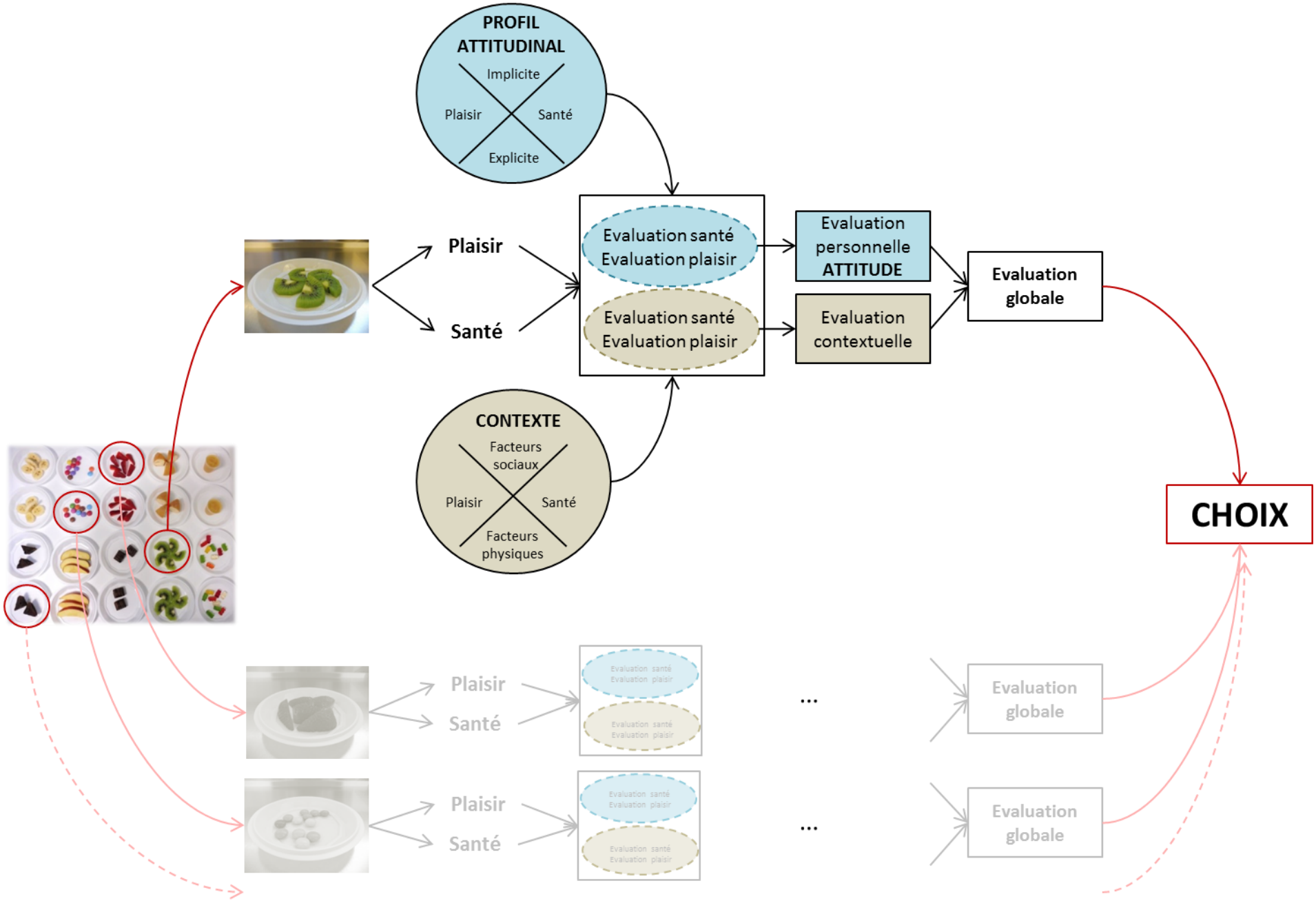


**Figure 19**. Schéma des liens potentiels entre profil attitudinal, contexte et choix alimentaires

## 5.3. Questions de recherche et hypothèses

### *5.3.1. Question 1 : Comment mesurer un profil attitudinal santé/plaisir chez l'enfant ?*

Les attitudes peuvent être mesurées de manière directe, pour avoir accès aux attitudes explicites qui guident les comportements délibérés et réfléchis, ou indirecte, pour avoir accès aux attitudes implicites, qui guident les comportements automatiques ou spontanés. Le défi méthodologique était donc de développer deux tâches, l'une directe, l'autre indirecte, adaptées aux enfants de 5 à 11 ans et permettant de mesurer la dominance relative des bases affectives et cognitives des attitudes, respectivement explicites et implicites, envers l'alimentation.

Etant donné l'émergence précoce du processus de prise de décision alimentaire chez l'enfant (Holsten et al., 2012; McNeal, 1999), nous faisons l'hypothèse que des enfants de 5 à 11 ans auraient déjà développé des attitudes implicites et explicites envers leur alimentation. De plus, compte tenu à la fois du caractère précoce du plaisir alimentaire, et du fait que dès l'âge de 5 ans, les enfants disposent de connaissances nutritionnelles suffisantes pour classer les aliments comme « bons » ou « mauvais » pour la santé (Nguyen, 2008), nous faisons l'hypothèse que leurs attitudes envers l'alimentation pourraient être basées sur des considération affectives (i.e., en lien avec le plaisir) ou cognitives (i.e., en lien avec la santé) dès l'enfance.

Le développement de l'outil permettant de mesurer le profil attitudinal santé/plaisir sera abordé au **CHAPITRE 2**.

### *5.3.2. Question 2 : Quels sont les déterminants du profil attitudinal santé/plaisir chez l'enfant ?*

Les attitudes, aussi bien implicites qu'explicites, résultent des expériences passées d'un individu avec l'objet attitudinal (Greenwald & Banaji, 1995). Les attitudes envers l'alimentation des enfants, ainsi que les bases affectives ou cognitives sur lesquelles elles reposent, sont donc construites au fil de leurs expériences alimentaires. Or, ces expériences alimentaires peuvent dépendre des caractéristiques individuelles de l'enfant, comme son

niveau scolaire, son statut pondéral ou son milieu culturel. Ces caractéristiques individuelles pourraient donc être associées à des différences de profil attitudinal chez les enfants.

Nous faisons l'hypothèse que la dominance relative des bases affectives et cognitives des attitudes envers l'alimentation des enfants est susceptible de varier en fonction de leur niveau scolaire (entre 5 et 11 ans), de leur statut pondéral (poids normal ou en surpoids) et de leur milieu culturel (France ou Etats-Unis).

Les déterminants du profil attitudinal santé/plaisir seront abordés au **CHAPITRE 3**, incluant les **Articles 1, 2 et 3**.

### *5.3.3. Question 3 : Quelle est l'influence du profil attitudinal santé/plaisir sur les choix alimentaires des enfants ?*

Le profil attitudinal détermine la dominance relative des bases affectives et cognitives des attitudes implicites et explicites des enfants envers leur alimentation. Or, privilégier des critères de plaisir ou de santé lors d'un choix alimentaire peut conduire à une évaluation différente des aliments à disposition et donc à des choix différents. De plus, selon différents modèles prédictifs (Perugini, 2005), à la fois les attitudes implicites et explicites sont susceptibles d'influencer les choix alimentaires. Différents profils attitudinaux pourraient donc conduire à des choix alimentaires différents chez les enfants.

Nous émettons deux hypothèses alternatives quant à l'influence des profils attitudinaux sur la qualité nutritionnelle des choix alimentaires des enfants. D'une part, il est communément supposé, notamment lors des interventions nutritionnelles, qu'être informés et concernés par la valeur santé des aliments encouragerait les enfants à choisir des aliments « meilleurs » pour la santé (Knai et al., 2006; Waters et al., 2011; Wolfenden et al., 2012). Dans cette perspective, des attitudes envers l'alimentation à dominance cognitive (i.e., santé) devraient favoriser le choix d'aliments « bons » pour la santé chez les enfants. D'autre part, certaines études interculturelles chez l'adulte avancent que le plaisir alimentaire pourrait être associé à une alimentation plus équilibrée (Rozin et al., 1999; Saulais et al., 2012). Dans ce cas, des attitudes envers l'alimentation à dominance affective (i.e., plaisir) devraient promouvoir le choix d'aliments « bons » pour la santé chez les enfants.

L'influence du profil attitudinal santé/plaisir sur les choix alimentaires des enfants sera abordée au **CHAPITRE 4**, incluant l'**Article 4**.

### *5.3.4. Question 4 : Quelle est l'influence du contexte santé/plaisir sur les choix alimentaires des enfants normo-pondéraux et en surpoids ?*

Le contexte de consommation a une influence indéniable sur les choix alimentaires (Connors et al., 2001; Sijtsema et al., 2002). Nous avons identifié qu'à la fois des facteurs sociaux (Cruwys et al., 2015) et physiques (Savage et al., 2007; Story & French, 2004; Strasburger, 2006) pouvaient influencer les comportements alimentaires des enfants, et que ces influences pourraient être modulées par leur statut pondéral (Carnell et al., 2013). Selon le contexte de consommation, des critères liés au plaisir alimentaire ou à la santé sont susceptibles d'être plus ou moins pris en compte dans le processus de choix. Différents contextes, évoquant le plaisir ou la santé au travers de facteurs sociaux ou physiques pourraient donc conduire à des choix alimentaires différents chez les enfants. Nous ajoutons que leur influence pourrait varier en fonction du statut pondéral des enfants.

Concernant le contexte social, nous faisons l'hypothèse qu'un contexte plaisir (e.g., un goûter d'anniversaire) versus un contexte santé (e.g., un goûter suite à une intervention sur la nutrition à l'école) conduiraient les enfants à faire des choix alimentaires différents en termes de qualité nutritionnelle. Les choix lors du goûter d'anniversaire devraient refléter la norme sociale concernant les aliments « plaisir », tandis que les choix lors de l'intervention nutritionnelle devraient refléter la norme sociale concernant les aliments « santé » chez les enfants. De plus, nous suggérons que l'influence du contexte social pourrait être différente chez les enfants normo-pondéraux et en surpoids, bien qu'aucune étude préalable ne nous permettent d'orienter notre hypothèse.

Concernant le contexte physique, nous avons choisi de manipuler le contexte olfactif au cours d'un choix alimentaire au travers d'un paradigme d'amorçage olfactif. En effet, un stimulus a d'autant plus de chance d'influencer un comportement qu'il est fréquemment associé à celui-ci. Or, une odeur alimentaire est la plupart du temps reliée à une situation de consommation alimentaire, plus qu'un stimulus visuel par exemple. Les stimuli olfactifs utilisés sont une odeur d'aliment palatable (e.g., une odeur d'aliment gras-sucré, le quatre-quarts) et une odeur d'aliment « bon » pour la santé (e.g., une odeur de fruit, la poire). Nous faisons l'hypothèse que l'odeur de poire devrait conduire les enfants à effectuer plus de choix d'aliments « bons » pour la santé, et l'odeur de quatre-quarts plus de choix d'aliments palatables, par rapport à une condition contrôle sans odeur. De plus, compte tenu des résultats antérieurs relatifs à l'influence des odeurs alimentaires sur les comportements alimentaires

des enfants normo-pondéraux et en surpoids (Jansen et al., 2003; Soussignan et al., 2012), nous faisons l'hypothèse que les enfants en surpoids devraient être plus sensibles à l'amorçage olfactif que les enfants normo-pondéraux. En d'autres termes, ils choisiraient plus d'aliments « bons » pour la santé avec l'odeur de poire, et plus d'aliments palatables avec l'odeur de quatre-quarts, comparés aux enfants normo-pondéraux.

L'influence du contexte santé/plaisir sur les choix alimentaires des enfants normo-pondéraux et en surpoids sera abordée au **CHAPITRE 5**, incluant les **Articles 5 et 6**.

# CHAPITRE 2 : CARACTÉRISER UN PROFIL ATTITUDINAL SANTE/PLAISIR

Ce chapitre explique et justifie les choix méthodologiques concernant la mesure des attitudes envers l'alimentation chez l'enfant. L'outil MIAM (Mesure via Internet du plaisir AliMentaire chez l'enfant), développé à cette fin et en amont de ce travail de thèse, est présenté dans ce chapitre.

# 1. Cahier des charges

## 1.1. Objectif

L'objectif de l'outil MIAM est de mesurer la dominance relative des bases affectives et cognitives des attitudes explicites et implicites envers l'alimentation chez les enfants de 5 à 11 ans. Cet objectif a des implications importantes concernant le développement de l'outil « MIAM ».

## 1.2. Mesurer une dominance relative entre les bases affectives et cognitives des attitudes

Mesurer une dominance relative entre les bases affectives et cognitives des attitudes, que nous appelons le « profil attitudinal santé/plaisir », implique de construire des tâches où l'on demande aux participants de choisir entre considérations affectives (i.e., liées au plaisir) et cognitives (i.e., liées à la nutrition ou à la santé). Par exemple, Dubé et Cantin (2000) ont mesuré la base dominante (i.e., affective ou cognitive) des attitudes envers des boissons chez des adultes au moyen d'une liste d'adjectifs. Cette liste comportait 16 adjectifs relatifs à des boissons : huit d'entre eux renvoyaient à des considérations affectives sensorielles (e.g., rafraîchissante, goûteuse), et les huit autres à des considérations cognitives nutritionnelles (e.g., bonne pour la santé, pleine de vitamines). Les participants devaient choisir seulement un adjectif, celui qu'ils trouvaient le plus adéquat pour qualifier la boisson qui leur était présentée. La nature affective ou cognitive de l'adjectif choisi permettait de déterminer, selon les auteurs, leur dominance attitudinale (i.e., affective ou cognitive) envers la boisson en question.

L'outil MIAM a été conçu sur le même principe que le questionnaire de Dubé et Cantin (2000) présenté au paragraphe précédent. Deux tâches à choix forcés ont été développées. Ces tâches amènent les enfants à privilégier une réponse liée au plaisir ou liée à la nutrition et à la santé et permettent ainsi de caractériser leur profil attitudinal santé/plaisir.

L'objectif n'est pas de déterminer quelle est la base attitudinale dominante envers un aliment en particulier, mais plus généralement envers l'alimentation de l'enfant. Ces tâches incluent donc une diversité d'aliments appartenant à différents groupes alimentaires (i.e., fruits et légumes, aliments gras, salés et sucrés, viande, œufs, poisson, fromage).

### 1.3. Mesures directes et indirectes des attitudes envers l'alimentation

Les attitudes peuvent être mesurées de manière directe, pour avoir accès aux attitudes explicites qui guident les comportements délibérés et réfléchis, ou indirecte, pour avoir accès aux attitudes implicites, qui guident les comportements automatiques ou spontanés. Deux tâches ont donc été développées, l'une indirecte, l'autre directe, permettant de caractériser respectivement le profil attitudinal santé/plaisir implicite et le profil attitudinal santé/plaisir explicite des enfants.

Parmi les instruments de mesures indirectes, l'IAT (Greenwald, McGhee, & Schwartz, 1998; Greenwald, Nosek, & Banaji, 2003) est sans nul doute le plus utilisé. Néanmoins, comme décrit au Chapitre 1, cette tâche mesure la différence entre l'attitude implicite envers un aliment A et l'attitude implicite envers un aliment B en accédant à l'évaluation automatiquement associée à ces aliments (e.g., positive / négative, bon / mauvais, bon pour la santé / mauvais pour la santé). Cette tâche ne permet donc pas de répondre à notre problématique qui nécessite de caractériser la dominance affective ou cognitive des attitudes implicites envers l'alimentation de l'enfant en général. Il a donc fallu s'inspirer d'une autre tâche. Sur la base des travaux de Rozin et al. (1999) qui ont évalué chez l'adulte la tendance à associer l'alimentation à un contexte nutritionnel ou culinaire au moyen d'un questionnaire[4], nous avons développé une *tâche d'association* permettant d'évaluer de manière indirecte la dominance affective ou cognitive des attitudes envers l'alimentation et donc de caractériser le profil attitudinal santé/plaisir implicite des enfants. En effet, il a été proposé que les attitudes implicites résultent d'un raisonnement associatif spontané (Greenwald et al., 2002; Karpinski & Hilton, 2001). Cette tâche consiste à demander au participant de choisir les deux aliments qui « vont le mieux ensemble selon lui » parmi trois (e.g., steak / poulet / frites). L'enfant peut effectuer soit une association hédonique en choisissant deux aliments qu'il aime manger ensemble (e.g., steak-frites), soit une association nutritionnelle en choisissant deux aliments

[4] La dimension du questionnaire de Rozin et al. (1999) qui a inspiré cette d'association implicite s'intitulait « Associations culinaires » et regroupait trois questions : (1) Entourez le mot que vous estimez le plus différent des trois autres : pain / pâtes / sauce, (2) carbohydrates / pain / beurre, et (3) Un « œuf au plat » va mieux avec : petit-déjeuner / cholestérol.

nutritionnellement similaires (e.g., steak-poulet qui sont tous les deux de la viande). Cette tâche est considérée comme une mesure indirecte de la dominance attitudinale santé/plaisir dans la mesure où aucun critère explicite de choix n'est donné à l'enfant a priori. Chaque enfant choisit spontanément d'effectuer une association soit selon un critère hédonique, soit selon un critère nutritionnel.

La mesure des attitudes explicites se fait classiquement via des échelles sur lesquelles les individus notent la pertinence de tel ou tel attribut pour un aliment donné (e.g., délicieux, bon pour la santé). Néanmoins, ces échelles ne permettent pas de caractériser la dominance affective ou cognitive des attitudes explicites. Sur la base des travaux de Dubé et Cantin (2000) présentés au paragraphe précédent, nous avons développé une *tâche de catégorisation* à choix forcé incluant des catégories soit affectives (i.e., « c'est miam » ou « c'est beurk ») soit cognitives (i.e., « ça donne des forces » ou « ça fait grossir ») et permettant donc d'évaluer de manière directe la dominance attitudinale santé/plaisir des enfants. En effet, les critères de catégorisation sont explicites et chaque enfant arbitre délibérément entre le critère nutritionnel (« ça donne des forces » / « ça fait grossir ») ou hédonique (« c'est miam » / « c'est beurk »).

### 1.4. Développer des tâches adaptées aux enfants de 5 à 11 ans

Cet outil étant destiné à des enfants de 5 à 11 ans, il a fallu réfléchir au développement de tâches attrayantes et pertinentes pour des enfants. Tout d'abord, les enfants de 5 et 6 ans ne sont généralement pas lecteurs. Nous avons donc opté pour des images d'aliments et des consignes énoncées à haute voix. De plus, le support devait être familier et ludique afin de susciter l'intérêt des enfants. Dans cette optique, nous avons choisi de présenter les tâches sous forme de jeux sur tablettes tactiles.

Afin de s'assurer que le contenu des tâches était adapté aux enfants un pré-test a été mené auprès de 27 enfants de 5 à 11 ans, qui n'ont pas ensuite participé aux phases expérimentales. Ce pré-test présentait plusieurs objectifs. Tout d'abord, il s'agissait de sélectionner des images d'aliments familiers pour des enfants de 5 à 11 ans. Seules les images correctement identifiées par au moins 95% des enfants participant au pré-test ont été incluses dans les tâches. Ensuite, ce pré-test a permis de sélectionner les pictogrammes correspondant aux catégories de la tâche de catégorisation. On présentait aux enfants des pictogrammes supposées refléter les différentes catégories et on leur demandait de décrire ce qu'ils

représentaient selon eux. Finalement, les pictogrammes décrits de manière adéquate (i.e., qui évoquaient aux enfants les notions bon / mauvais au goût et bon / mauvais pour la santé) par au moins 95% des enfants ont été retenues. Les labels attachés aux pictogrammes (i.e., « c'est miam », « c'est beurk », « ça donne des forces » et « ça fait grossir ») ont été choisi sur la base des mots qu'employaient les enfants pour les décrire. Enfin, il a été vérifié que les consignes étaient bien comprises par les enfants.

## 2. La tâche d'association

Au cours de la tâche d'association, l'enfant voit apparaître à l'écran de la tablette tactile trois images d'aliments. Il lui est demandé de choisir les deux aliments qui « vont le mieux ensemble selon lui » parmi les trois (**Figure 20**). A partir des trois aliments qui s'affichent à l'écran (e.g., steak / poulet / frites), l'enfant peut effectuer soit une association hédonique en choisissant deux aliments qu'il aime manger ensemble (e.g., steak-frites), soit une association nutritionnelle en choisissant deux aliments appartenant au même groupe alimentaire (e.g., steak-poulet, qui sont tous deux de la viande).

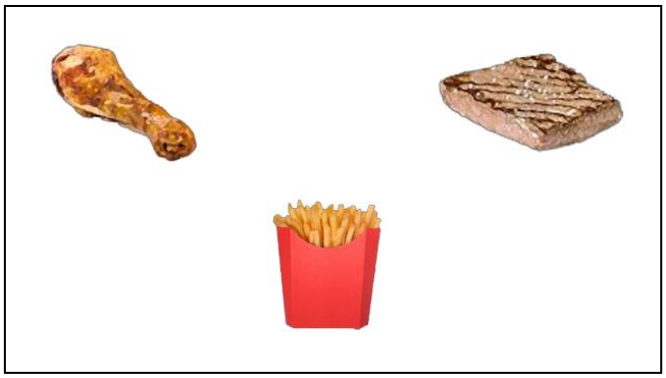

**Figure 20.** Exemple d'affichage lors de la tâche d'association

Un pré-test a été conduit auprès de 37 enfants spécifiquement pour s'assurer que les triplets d'images d'aliments étaient pertinents et qu'une association considérée comme hédonique (ou au contraire nutritionnelle) était effectivement justifiée par des motivations hédoniques (ou au contraire nutritionnelles) par les enfants. Douze triplets ont ainsi été testés. Après chaque association il était demandé aux enfants pourquoi les deux aliments qu'ils avaient choisis allaient le mieux ensemble selon eux et on enregistrait leurs *verbatims*. L'analyse des *verbatims* des enfants est développée dans l'**Article 1**. Les résultats montrent que les associations sont justifiées de manière adéquate pour 11 des triplets proposés. Le

triplet salade / tomate / huile d'olive a été exclu suite à l'analyse des *verbatims* qui a révélé que la majorité des enfants ayant effectué une association supposée nutritionnelle (i.e., salade-tomate) la justifiaient par un argument hédonique (e.g., « j'aime manger de la salade avec des tomates »).

Finalement, la tâche d'association comporte 11 triplets d'aliments, dont un triplet d'entraînement (fraise / framboise / chantilly) suivi de 10 triplets tests présentés à l'écran dans un ordre aléatoire (baguette / pain de mie / confiture ; baguette / beurre / Nutella® ; tomates / huile d'olive / mayonnaise ; cigarettes russes / cookies / compote ; poulet / steak / frites ; gaufre / crêpe / confiture ; petit-beurres / cookies /compote ; poulet / frites / potatoes ; salade de fruits / cigarettes russes / compote ; pâtes / riz / steak). Les consignes sont données par une voix enregistrée sur la tablette. Les enfants donnent leurs réponses en appuyant sur les deux aliments qui vont le mieux ensemble selon eux. Leurs réponses sont enregistrées sur la tablette. Cette tâche dure environ 5 minutes.

On considère que l'attitude implicite de l'enfant envers son alimentation est d'autant plus hédonique que la proportion d'associations hédoniques sur les 10 triplets présentés est élevée et au contraire d'autant plus nutritionnelle que la proportion d'association nutritionnelles est élevée.

## 3. La tâche de catégorisation

Au cours de la tâche de catégorisation, 51 images d'aliments apparaissent successivement à l'écran de la tablette tactile (**Figure 21**). L'enfant doit classer les trois aliments d'entraînement (banane, sucette et riz) puis les 48 aliments tests, présentés dans un ordre aléatoire, dans l'une des catégories suivantes : « ça donne des forces », « ça fait grossir », « c'est beurk », « c'est miam » ou « je ne connais pas cet aliment ».

Les aliments tests proposés appartiennent à quatre groupes d'aliments : les fruits et légumes (pomme, raisin, orange, melon, pamplemousse, poire, kiwi, pêche, salade de fruits, tomate, carottes râpées, concombre, haricots verts, petits pois, soupe de légumes, courgettes, poêlée de légumes, ratatouille et lentilles), les viandes, œufs et poissons (filet de poisson, pavé de saumon, steak, côtelettes d'agneau, œuf au plat, omelette), les aliments gras, salés et sucrés (hamburger, lasagnes, pizza, frites, chips, bretzels, quiche, croissant, petit-beurre, bonbons, chocolat, barre chocolatée, éclair au chocolat, esquimau à la fraise, crème caramel, glace, tarte

aux pommes, gâteau au chocolat, Danette®) et les fromages (camembert, roquefort, fromage de chèvre, gruyère). Les consignes sont données par une voix enregistrée sur la tablette. Les enfants donnent leurs réponses en appuyant sur l'image correspondant à la catégorie qu'ils ont choisie. La tablette enregistre leurs réponses. Cette tâche dure environ 15 minutes.

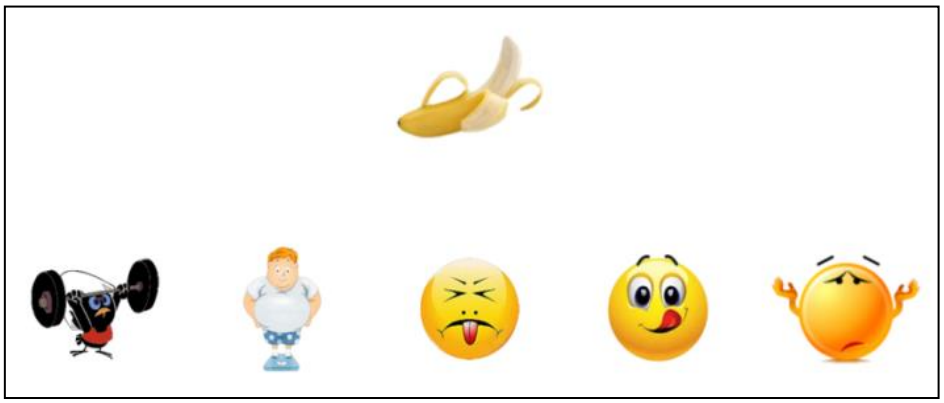

**Figure 21.** Exemple d'affichage lors de la tâche de catégorisation

On considère que l'attitude explicite de l'enfant est d'autant plus hédonique que la proportion de catégorisations hédoniques (« c'est miam »/« c'est beurk ») parmi les aliments connus est élevée et au contraire d'autant plus nutritionnelle que la proportion de catégorisations nutritionnelles (« ça donne des forces », « ça fait grossir ») est élevée.

## 4. Définition méthodologique du profil attitudinal santé/plaisir

Sur la base des tâches d'association et de catégorisation sont calculés un score hédonique d'association (i.e., le pourcentage d'associations hédoniques sur les 10 triplets tests) et un score hédonique de catégorisation (i.e., le pourcentage de catégorisations hédoniques sur les 48 aliments tests). Nous faisons l'hypothèse que ces scores hédoniques reflètent respectivement la dominance de la base affective des attitudes implicites et explicites envers l'alimentation chez les enfants. On appellera donc « profil attitudinal santé/plaisir » la combinaison des scores hédoniques d'association (i.e., le « profil attitudinal santé/plaisir implicite ») et de catégorisation (i.e., le « profil attitudinal santé/plaisir explicite »).

# CHAPITRE 3 : LES DÉTERMINANTS DU PROFIL ATTITUDINAL SANTE/PLAISIR

# Article 1

**Explicit and implicit tasks for assessing hedonic- versus nutrition-based attitudes towards food in French children**

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## OBJECTIFS & PRINCIPAUX RESULTATS

L'objectif de l'**Article 1** était d'étudier la dominance relative des bases hédoniques et nutritionnelles des attitudes implicites et explicites envers l'alimentation en fonction du niveau scolaire des enfants de 5 à 11 ans.

Nous avons mis en évidence une augmentation avec le niveau scolaire des enfants de la dominance de la base hédonique des attitudes implicites au détriment de la base nutritionnelle. A l'inverse, nous avons mis en évidence une diminution avec le niveau scolaire de la dominance de la base hédonique des attitudes explicites au profit de la base nutritionnelle.

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# Explicit and implicit tasks for assessing hedonic-versus nutrition-based attitudes towards food in French children

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ABSTRACT

Attitudes are important precursors of behaviours. This study aims to compare the food attitudes (i.e., hedonic- and nutrition-based) of children using both an implicit pairing task and an explicit forced-choice categorization task suitable for the cognitive abilities of 5- to 11-year-olds. A dominance of hedonically driven attitudes was expected for all ages in the pairing task, designed to elicit affective and spontaneous answers, whereas a progressive emergence of nutrition-based attitudes was expected in the categorization task, designed to involve deliberate analyses of the costs/benefits of foods. An additional exploratory goal was to evaluate differences in the attitudes of normal and overweight children in both tasks.

Children from 3 school levels (n = 194; mean age = 8.03 years) were individually tested on computers in their schools. They performed a pairing task in which the tendencies to associate foods with nutritional vs. culinary contexts were assessed. Next, they were asked to categorize each food into one of the following four categories: "yummy", "yucky" (i.e., hedonic categories), "makes you strong", or"makes you fat" (i.e., nutritional categories).

The hedonic/culinary pairs were very frequently selected (81% on average), and this frequency significantly increased through school levels. In contrast, in the categorization task, a significant increase in nutrition-driven categorizations with school level was observed. Additional analyses revealed no differences in the food attitudes between the normal and overweight children in the pairing task, and a tendency towards lower hedonic categorizations among the overweight children.

Culinary associations can reflect cultural learning in the French context where food pleasure is dominant. In contrast, the progressive emergence of cognitively driven attitudes with age may reflect the cognitive development of children who are more reasonable and influenced by social norms.



## 1. Introduction

### 1.1. Attitudes are important precursors of behaviours

Attitudes are generally described as memory structures that are activated when an object is encountered to reflect an individual's acquired predisposition towards that object and involve cognitive and affective bases (Eagly & Chaiken, 1998). In the food domain, the cognitive components of attitudes reflect the positive and negative attributes and beliefs about foods (e.g., nutritional and health values), while the affective components pertain to sensations and emotions that are experienced in response to foods (e.g., taste, likes and dislikes) (Dubé & Cantin, 2000). Attitudes towards food have been shown to predict consumption (e.g., Conner, Perugini, O'Gorman, Ayres, & Prestwich, 2007). Eating behaviours have been found to remain stable between early childhood, childhood, the teenage years and adulthood (Nicklaus, Boggio, Chabanet, & Issanchou, 2004, 2005; Skinner, Carruth, Bounds, & Ziegler, 2002) and to be minimally modifiable in the long-term (Köster, 2009; Lumeng, Cardinal, Jankowski, Kaciroti, & Gelman, 2008; Rozin, 1980). Accordingly, the identification of attitudes towards food in

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children could be of interest for addressing the early psychological determinants of eating behaviours, and in particular of food choices.

Childhood is a critical period for establishing personal relationship with food and eating. Since the last neo-piagetian cognitive developmental theories of the eighties, the majority of the studies that have evaluated attitudes related to food have primarily focused on the cognitive dimensions of eating in children, such as nutritional knowledge, in relation to parental eating and feeding practices, demographics, and obviously the nutritional content of the children's daily meals (Contento, Randell, & Basch, 2002). However, the affective dimension of food (i.e., the hedonic perception) is currently considered to be a major multidimensional construct in eating-related research in children, and the cultivation of this dimension throughout the teenage years and adulthood could actually turn out to be protective of later health as suggested in the studies conducted by Rozin, Fischler, Imada, Sarubin, and Wrzesniewski (1999). For example, these authors observed that attitudes in France are more food pleasure-oriented and less food health-oriented than those in the U.S.A., where foods often seem to be more of a focus of worry than pleasure; paradoxically, cardiovascular disease occurs at much lower rates in France than in the U.S.A. (i.e., the "French paradox"; Rozin et al., 1999). The origin of food pleasure-oriented attitudes can be observed in the very early stages in life (Nicklaus, 2015). It has been shown that pleasure and taste development are considered to be of primary importance to weaning by French mothers; in contrast, British mothers emphasize on health and nutrient qualities and not "palate" or "taste/flavour" development (Caton, Ahern, & Hetherington, 2011; Schwartz et al., 2013). For Rigal (2010), hedonic pleasure is a prerequisite for the regular consumption of food at the age of weaning.

Only quite recently has the relationship between affective and cognitive dimensions of eating been studied *via* research on the eating behaviours in adults (Dubé et al, 2003; Jacquier, Bonthoux, Baciu, & Ruffieux, 2012). However, the affective and the cognitive dimensions of food attitudes may not be appropriately conceived as two opposite sides of a coin. What defines an attitude as affectively driven or cognitively driven can be more accurately envisioned as a marker placed on continuum with extremes that are defined by theoretical affective and cognitive anchors (Edwards & von Hippel, 1995). Commercial and marketing research has attempted to account for this continuum by building predictive models of the adult food decision-making process that led to the foundations of neuroeconomics (Petit, Basso, Huguet, Plassmann, & Oullier, 2011). However, the majority of studies of the attitudes of younger participants have focused on the cognitive dimensions of eating, in children (Le Bigot Macaux, 2001) and adolescents (Guidetti, Conner, Prestwich, & Cavazza, 2012) and differences in the attitudes of children and their parents. Specifically, 9- to 11-year-old children have been described as viewing food primarily as a necessity of life, whereas their mothers view food primarily as a source of pleasure for their children (Le Bigot Macaux, 2001).

A recent study assessed both the nutritional and hedonic perceptions of healthy and less healthy foods among 5- to 9-year-old children using a structured sorting task with images (Varela & Salvador, 2014). The authors demonstrated that children from five years of age were able to manipulate multidimensional concepts because they were able to classify foods by accounting for both nutritional knowledge and hedonic information in an explicit sorting task. Another method for exploring the multidimensional aspects of attitudes towards foods is comparing the results from both implicit and explicit tasks (Craeynest et al., 2005). In one study that employed this method and involved 9- to 18-year-olds, the authors compared explicit attitudes that were thought to reveal deliberate and conscious analyses of the costs and benefits of behaviours (using a valence scale) with implicit attitudes thought to reveal affective and spontaneous behaviours using the Implicit Association Task (Craeynest, Crombez, Haerens, & De Bourdeaudhuij, 2007; Greenwald, McGhee, & Schwartz, 1998). The authors looked for differences in attitudes between obese and normal-weight subjects and found no differences in the explicit task; both groups reporting similar liking for healthy and unhealthy foods. However, in the implicit task, contrary to their expectations, the obese participants exhibited positive implicit attitudes towards both the healthy and unhealthy foods, and this effect was not observed in the normal-weight subjects. The authors suggested that the obese participants did not prefer unhealthy foods but simply liked eating. This result highlights the need to address differences in children's food attitudes according to their weight statuses.

The goal of the present research was to compare food attitudes (affectively and cognitively based) in children using both implicit and explicit tasks that were suitable to the cognitive abilities of 5- to 11-year-old children. Moreover, this is the first study to evaluate these aspects in French children. An additional exploratory goal of the present study was to evaluate the potential differences in attitude dominances between the normal-weight and overweight children and between the boys and girls in both tasks. Towards these aims, an implicit pairing task that was inspired by Rozin's association task and an explicit categorization task (Berger, 1997) were developed. In the implicit pairing task, triplets of foods pictures (for example, steak, chicken, and French fries) were successively presented to the children who were simply asked to select the 2 foods from the 3 that they though fit well together. Notably, no criteria for selection were given with the goal of recording the nature of the pairings (culinary or nutritional) that were spontaneously made by the children. This task of pairing obviously requires reflexivity and cognitive action, but makes it possible to explore in an implicit way the dominance of culinary or nutritional associations made by the child when no criteria were given. In other words, because this task does not involved a direct explicit analysis of the potential benefits of food, this task may be more sensitive to affective or cultural aspects of foods than explicit tasks, as demonstrated by Rozin et al. (1999). In the explicit categorization task, the children were directly asked to categorize pictures of foods in a 4-alternative forced-choice procedure (the choices were '*yummy*', '*yucky*', '*it makes you fat*', and '*it makes you strong*'). To assess the dynamics of attitude dominance (i.e., hedonic- or nutrition-based) through development, 3 school levels were considered (approximately 5, 8 and 10 years old).

Because early eating preferences seem to be primarily linked to the affective or hedonic dimensions of food and less strongly linked to health-related features (Rigal, 2010), we expected to observe a dominance of hedonic-driven attitudes (i.e., culinary associations) in the implicit pairing task because this task was supposed to assess more spontaneous behaviours. In the forced-choice categorization task, we also expected a dominance of hedonic-driven attitudes and a progressive emergence of cognitively driven attitudes among the older school levels compared to the younger one because this task involved a more direct explicit analysis of the potential benefits of food. Based on the literature, different hedonic scores were expected between the overweight and normal-weight children. Our analysis of the literature did not lead us to formulate a specific hypothesis concerning the potential differences between the boys and girls.

## 2. Method

### 2.1. Ethics

The study was conducted in accordance with the Declaration of

Helsinki and was approved by the local ethical committee (*Comité pour la Protection des Personnes EST-1 Burgundy, file number: 2012-A00845-38*). Written informed consent was obtained from both parents for all of the children. We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were adhered to during this research study.

### 2.2. Participants

One hundred and ninety four children (86 girls and 108 boys) were recruited in five different schools in Dijon and its suburbs (France) and grouped according to their school grade level as follows: school level 1 corresponded to the higher grade of kindergarten, school level 2 corresponded to the 'elementary' grades defined as CE1 and CE2, and school level 3 corresponded to the 'median' grades defined as CM1-CM2. The participating children were aged from 5.08 to 11.84 years (mean age ± SEM = 8.03 ± 0.13). Level 1 included 49 children (mean age ± SEM = 5.56 ± 0.04), level 2 included 95 children (mean age ± SEM = 8.15 ± 0.06), and level 3 included 50 children (mean age ± SEM = 10.20 ± 0.1). When the data were available, the children's BMIs were calculated and converted into standardized z-scores based on French norms (Rolland-Cachera et al., 1991; Rolland-Cachera et al., 2002). The BMI z-scores were calculated for the 115 children and ranged from −2.31 to 7.04 for the girls (mean ± SEM = 0.56 ± 0.22) and −8.73 to 4.65 for the boys (mean ± SEM = 0.10 ± 0.24). In this sample, 13 children were considered overweight (BMI z-score ≥ 2).

### 2.3. Materials and procedures

The test session involved two tasks, i.e., a pairing task and a forced-choice categorization task that were adapted for young children to account for their limited attention spans. The children were individually tested in a quiet room in their school. The tasks were self-administered. An experienced interviewer was present to give the initial instruction and was available for consultation if needed. The tasks were developed on PC computer software (Windows XP, compatible with 8.1) with a sound card for the instructions.

### 2.4. Pairing task

The pairing task was inspired by the original food culinary pairing task of Rozin et al. (1999), which measures whether a participant associates a food term preferentially with a culinary term (e.g., bread–butter) or with a nutritional term (bread–carbohydrate) by having the participant circle the word that he/she believes is the most different from the other two. In the present study, the children performed an adapted version of the food culinary pairing task. Here, pictures of foods were included, and the instructions were changed to "choose the 2 foods that go best together" among food triplets (for example, steak, chicken, and French fries). Thus, a child could perform a culinary association by pairing two food items that are typically consumed together (for example, steak with French fries or chicken with French fries) or a nutritional association by pairing the two nutritionally similar food items (for example, steak with chicken because they both belong to the meat category). Ten triplets of foods were successively presented rather than the 3 used in Rozin's study.

A pre-test was performed previously with another sample of children from the same school levels as the main study test sample (N = 27, mean age = 8.45 years, 7 girls, mean age of level 1 = 5.98, mean age of level 2 = 8.19, mean age of level 3 = 9.93). The aim of the pre-test was to determine whether the foods in the pictures were identifiable, to ensure that only highly identifiable foods (>95%) were included, to select triplets that made sense to the children and to examine their understandings of the instructions. During the pre-test, the verbatim of the children were also recorded after each association in the pairing task. The aim of this qualitative approach was to check the motivations underlying each association, to make sure that the associations such as Nutella-butter or peas-beans (coded as nutritional association) were justified by nutritional consideration (for instance, 'it is fat', 'there are vegetables'); or that the associations such as bread-jam or pasta-sauce (coded as hedonic association) were motivated by culinary consideration (for example, 'I like to put jam on bread', 'I prefer pasta with sauce'). The qualitative analysis showed that the associations were indeed based on nutritional or culinary motivations; except for some triplets for which associations were justified by criteria based on the shape and/or on the colour of the foods (i.e. cucumber-zucchinis). It is remarkable to note that the visual associations were mostly observed with the younger children. Thus, to avoid any confusion, these triplets were excluded from the version of the pairing test reported here.

Finally, eleven triplets of 3 pictures of foods were ultimately selected and included an initial training triplet (strawberry, raspberry and Chantilly), followed by 10 test triplets that were presented at random ("baguette", butter and Nutella; tomato, olive oil and mayonnaise; cigarette biscuits, chocolate chip cookies and stewed fruit; white bread, "baguette" and jam; chicken, steak and chips; waffle, crepe and jam; biscuits, chocolate chip cookies and stewed fruit; chicken, chips and country potatoes; fruit salad, cigarette biscuit and stewed fruit; pasta, rice and steak. All the pictures are available upon request).

The task allowed for the recording of the children's answers (i.e., culinary or nutritional associations). The instructions and names of each food were orally provided by the computer when the food pictures appeared on the screen. For each triplet, the children gave their answers by clicking on the 2 pictures of food that they thought fit well together. No feedback was given. The pairing task required approximately 5 min.

### 2.5. Forced-choice categorization task

The forced-choice categorization task used in the present study was inspired by Berger's analyses of children's categorization tools (Berger, 1997) and adapted to the study of the cognitive vs. affective dimensions of food attitudes. Forty-nine pictures of highly identifiable foods (for at least 95% of children) were selected based on a previous pre-test with 27 children as described in the 'pairing task' section. The selected test food items included 9 fruits (apple, grapefruit, orange, melon, grape, pear, kiwi, nectarine, and fruit salad) and 10 vegetables (tomato, shredded carrots, cucumber, green beans, peas, vegetable soup, zucchini, fried vegetables, ratatouille and lentils) that were aggregated in the "fruits and vegetables" group, 6 animal protein dishes (fish fillet, salmon steak, beefsteak, lamb chop, fried egg, and omelette) and 4 cheeses (gruyere, camembert, Roquefort, and goat) that were aggregated in the "meat, fish, eggs and cheese" group, and 4 high-fat dishes (hamburger, lasagne, pizza, and chips), 3 salted snacks (crisps, pretzel, and small quiche), 5 sweet snacks (croissant, biscuit, candy, chocolate, and candy bar), and 8 desserts (chocolate éclair, strawberry ice-lolly, "crème caramel", ice cream, apple pie, chocolate cake, chocolate cream, and strawberry tart) that were aggregated in the "foods high in fat, salt and sugar" group. An additional 3 food items were selected for training (banana, lollipop, and rice). In the forced-choice categorization task, the children were simply asked to choose whether each of the 49 foods was "yummy" ("*c'est miam*" in French), "yucky" ("*c'est beurk*") (hedonic dimension), "makes you strong" ("*ça donne des forces*") or "makes you fat" ("*ça fait grossir*")

(nutritional dimension). Another category termed "*I don't know this food*" was also available. The choices were represented by pictures that were also pre-tested (see Fig. 1) to ensure that the pictures reflected what they were supposed to represent. To this aim, the children involved in the pretest (previously described; N = 27) were presented with different pictures (smileys, picture of characters …) supposed to reflect the different categories (yummy, yucky, makes you strong, makes you fat, I don't know this food). Children were simply asked to describe what each picture was supposed to represent. Finally, we selected the pictures that were correctly labelled for the purpose of the study at least in 95% of the cases. Notably, each dimension (hedonic, nutritional) paralleled two a priori opposite sides (*yummy*|*yucky*; *strong*|*fat*). Each food picture was individually presented in the centre of the screen of the computer, and the different answer categories were constantly maintained in the background of the screen.

As in the pairing task, the forced-choice categorization task allowed for the recording of the children's answers (i.e., positive or negative affective attitudes, positive and negative cognitive attitudes, and unknown foods). The instructions and the name of each food were orally provided by the computer. For each food picture, the children provided their answer by clicking on one of the 5 category pictures. No feedback was given. This task required approximately 15–20 min.

### 2.6. Data analysis

#### 2.6.1. Pairing task scoring

A hedonic score based on the percentage of culinary associations was calculated for each child (range: 0%–100%). This score was hypothesized to reflect an implicit hedonically based attitude toward food.

#### 2.6.2. Forced-choice categorization task scoring

First, the "I don't know this food" answers were excluded. A hedonic score based on the percentage of hedonic answers (i.e., "yummy" or "yucky") was calculated for each child (range: 0%–100%) for the remaining foods. This score was hypothesized to reflect an explicit hedonically based attitude towards food.

### 2.7. Statistical methods

The statistical analyses were performed using the SAS software version 9.3 (SAS Institute SAS Institute Inc. 2012 *SAS® 9.3*. Cary, NC: SAS Institute Inc.).

ANOVAs were performed to test whether the effects of school level and gender and the interaction between school level and gender on the pairing and categorization task scores were significant. An additional analysis was performed for the categorization task to determine whether the "yummy" answer was influenced by the food group. To this end, the children's answers for each food item were encoded as 1 or 0 according to whether the child chose the "yummy" category or not, respectively. In this manner a binarily distributed "yummy" variable was obtained. To test the effects of the food groups on the "yummy" variable, the child effect and the food item effect were considered random. This model was estimated using the GLIMMIX procedure, which assumes random effects on binarily distributed variables.

Post hoc comparisons (Student's t-tests with Bonferroni corrections) were used to compare the means when relevant. A Pearson's correlation was used to assess the relationship between the pairing and forced-choice categorization task scores. Non-parametric statistics were used to compare the overweight and normal-weight children due to the small number of overweight children. Wilcoxon's two-sample tests were used to compare the quantitative variables, and Chi-square tests were used to compare the qualitative variables. $P < 0.05$ was chosen as the threshold for statistical significance.

## 3. Results

### 3.1. Pairing task

The percentage of culinary associations was very high (mean ± SEM = 81.4 ± 1.59%), which was suggestive of the dominance of hedonic-based attitudes in the children. An ANOVA revealed a significant effect of school level on the hedonic scores in the pairing task ($P = 0.0003$) and no significant effect of gender ($P = 0.46$) or school level × gender interaction ($P = 0.87$). As shown in Fig. 2-A, higher percentages of culinary associations were reported by the older groups compared with the younger group (level 1: 71.0 ± 2.81%, level 2: 83.1 ± 2.38%, and level 3: 88.4 ± 2.72%). Post-hoc comparisons indicated significant differences between the school levels 1 and 2 ($P = 0.007$), and between the levels 1 and 3 ($P = 0.0003$) but not between levels 2 and 3 ($P = 0.44$). Finally, the binomial proportions of culinary associations were significantly greater than chance (0.66) at each level (level 1, $P = 0.02$, 95% lower-upper confidence limits [0.67–0.75], level 2, $P = 0.01$ [0.80–0.85], and level 3, $P = 0.01$ [0.85–0.91]), which confirmed the dominance of implicitly hedonically based attitudes in children.

### 3.2. Force-choice categorization task

The hedonic score was high (mean ± SEM = 63.5 ± 1.52%), which was suggestive of the dominance of hedonically based attitudes in children. An ANOVA revealed a significant effect of school level on the hedonic score in the categorization task ($P < 0.0001$) and no significant effect of gender ($P = 0.34$) or school level × gender interaction ($P = 0.47$). As shown in Fig. 2-B, we observed a decrease in the percentage of hedonic categorizations with school level (level 1: 79.3 ± 2.52%, level 2: 60.2 ± 2.20%, and level 3: 54.1 ± 2.11%). Post-hoc comparisons indicated significant differences between the school levels 1 and 2 ($P < 0.0001$), between levels 1 and 3 ($P < 0.0001$) and not between levels 2 and 3 ($P = 0.21$).

Additionally, we observed that the "yummy" category was the most frequently used (44% of the answers), whereas the other three categories were less used at equal levels (18% "it makes you strong", 17% "it makes you fat", and 16% "yucky"). The "I don't know this food category" was chosen the least frequently (5%). A mixed model

**Fig. 1.** The pictures from left to right represent the categories "yummy" and "yucky" for the hedonic dimension, "it makes you strong" and "it makes you fat" for the nutritional dimension, and 'I don't know this food'.

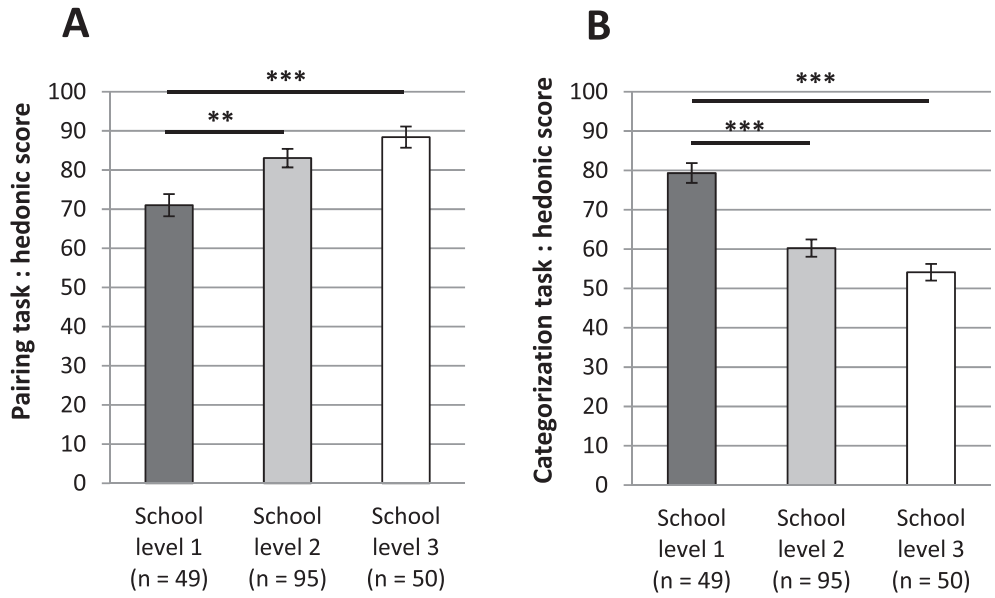


**Fig. 2.** Mean hedonic scores (±SEM) in the pairing and categorization tasks according to school level (school level 1: mean age ± SEM = 5.56 ± 0.04, school level 2: mean age ± SEM = 8.15 ± 0.06, and school level 3: mean age ± SEM = 10.20 ± 0.1). For each task, the hedonic scores according to school level were compared using post hoc *t* tests with Bonferroni corrections. $^{**}P < 0.01$, $^{***}P < 0.001$.

revealed a significant effect of the food group on the categorization as "yummy" ($P = 0.0003$). The percentage of items that were categorized as "yummy" was 47% among the foods that were high in fat, salt and sugar, which was significantly greater than the 42% for the fruits and vegetables ($P = 0.0002$). The meat, fish eggs and cheese were categorized as "yummy" at a rate of 44%, which was not significantly different from the fruits and vegetables ($P = 0.24$) or the foods that were high in fat, salt and sugar ($P = 0.20$).

### *3.3. Correlation between the implicit pairing and the explicit forced-choice categorization task scores*

The Pearson's correlation between the hedonic scores in the pairing task and the hedonic scores in the categorization task was not significant ($r = -0.08$, $P = 0.21$).

### *3.4. Food-attitude dominances in normal-weight and overweight children*

Fig. 3-A shows that there was no difference in the hedonic scores in the pairing task between the overweight (mean ± SEM = 83.8 ± 3.85%) and normal-weight children (80.4 ± 2.23). In contrast, the overweight children tended ($P = 0.08$) to exhibit lower hedonic scores (51.9 ± 5.98%) than the normal-weight children (64.9 ± 2.22) in the categorization task as shown Fig. 3-B. A Wilcoxon two-sample test did not reveal any difference in age between the overweight and normal-weight children ($P = 0.17$). A Chi-square test did not reveal any difference in the gender ratios of the two groups of children ($P = 0.94$).

## 4. Discussion

To our knowledge, this study represents the first attempt to compare hedonic- and nutrition-food based attitudes in children using both implicit and explicit tasks that were specifically created for this purpose and were suitable for the cognitive abilities of preschool and school-aged children.

The first expectation of the dominance of hedonically driven attitudes in the implicit pairing task was confirmed by the results that indicated a high percentage of culinary associations among the French children. A significant effect of school level on the hedonic scores was observed; i.e., the students in the higher school levels more frequently reported culinary associations than the students in the lower level. How should this effect be interpreted? This implicit task was thought to reflect affective and spontaneous behaviours. When the children were implicitly tested, a higher percentage of culinary associations were reported by the older children, which supports the dominance of hedonically driven behaviours, particularly among the higher school levels. In this context of implicit measures, the sensory and affective dimension seems to have been spontaneously predominant in the children relative to the nutrition-related features, and this effect increased with school levels. However, even in the younger children, culinary associations were reported at a rate greater than chance. Therefore, based on these results, it can be argued that hedonically driven attitudes are established quite early and are reinforced as children grow older. However, the observation that younger children could have a more nutritionally oriented attitude than older children may be surprising. This observation may be arising from the educational context, since when children in the kindergarten grades are taught about nutrition, this is generally done through sorting task, classification or games, and the fact that the present study was conducted in class could have primed them to perform more nutritional associations. However, because we did not check whether nutrition programmes had actually been disseminated in these schools with the teachers, we cannot confirm this intuition. Another explanation for the significant increase of hedonically driven attitudes with age could be advanced: this trend may simply reflect the greater experience in term of culinary script or cultural learning. So culinary associations can reflect progressive cultural learning in the French context, in which food pleasure is dominant. In this perspective, these results reveal in children the dominance of food pleasure-oriented associations that have previously been reported in French adults (Rozin et al., 1999).

In contrast, when the children were explicitly tested in the categorization test, the expected significant decrease in the

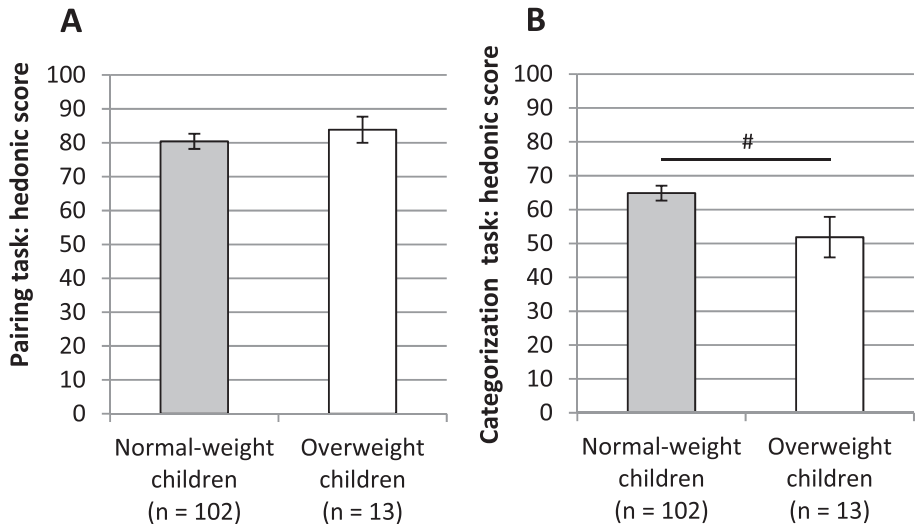


**Fig. 3.** Mean hedonic scores (±SEM) in the pairing and categorization tasks for the normal-weight and overweight children. For each task, the comparisons between the normal-weight and overweight children's scores were performed with Wilcoxon two-sample tests. $^{\#}P < 0.10$.

percentages of hedonic categorizations with school level was observed. Consequently, a progressive emergence of cognitive-driven attitudes in the older children relative to the younger children was observed. Nutritional categorizations increased with age, which reflected the cognitive development and increasing rationality of the children as they mature (Contento, 1981; Contento et al., 2002). Because this task involved a more explicit analysis of the potential benefits of the foods, it can be argued the children's answers were more prone to reflect social norms and/or familial ideas compared with the answers obtained in the implicit task. These results corroborate those of Young (2000) who reported that the cognitive dimension of health-related eating is highly represented in the explicit free-choice categorizations of foods by children between the ages of 6 and 12 years, whereas the affective dimension is only poorly represented in the free creation of categories (Young, 2000). Nevertheless, we found that the 'yummy' category was the most frequently chosen option, particularly for the foods that were high in fat, salt and sugar. These results demonstrate that explicit attitudes may vary according to food items, and that attitudes towards foods that are high in fat, salt and sugar may be more affective than attitudes towards other foods (Cantin & Dubé, 1999). In other words, affective attributes (e.g., taste and food enjoyment) appear to be more salient than health-related attributes, at least for very palatable foods, even when the task explicitly involves health-related considerations. One could argue that the categorization task may have activated societal or familial attitudes rather than personal attitudes towards the foods because the nutritional categories that were selected (i.e., "it makes you fat" and "it makes you strong") delivered common messages that are currently widely broadcasted by national French health campaigns, even in TV programmes for young children (for example, 'for your health, avoid eating fatty foods'). However, the fact that the children, particularly the younger children, preferentially selected hedonic personal categories (i.e., "yummy" and "yucky") over nutritional categories emphasizes the personal nature of the attitudes assessed here.

Our results highlight the differential influences of the natures of the tasks (i.e., explicit vs. implicit) on the children's answers and confirm the susceptibility of the explicit task to the children's normative responses with age. In agreement with Craeynest et al. (2007), who found no significant correlation between implicit and explicit self-reported attitudes, we found no significant correlation between the implicit association and the explicit forced-choice categorization task scores. This result supports the hypothesis that the sensitivities of the association and categorization tasks to social norms were different. Specifically, one could argue that the pairing task could reflect the impregnation and appropriation of cultural and social norms by children, whereas the categorization task could rather reflect inculcation of these norms (Dupuy & Poulain, 2008). As suggested by Birch, Billman, and Richards (1984), as young as three years, children "are not explicitly taught the(se) rules of food appropriateness; in most cases they must be inferred from the repeated association of food and context that the children experience in meal patterns generated by their elders." This observation is confirmed by the dominance of hedonic associations in the implicit pairing task. As the child grows, the socialization process becomes more and more explicit though education, family expectations and health promotion programmes, as revealed by the significant increase of nutritional categorizations through school level. This highlights that with age, children become more exposed to the culinary-oriented food context and to health promoting messages, which may create cognitive dissonance, which consequences on further food choices still remain to be explored.

Evidence of social and cultural differences in attitudes towards food has previously been demonstrated by Rozin and colleagues (Rozin et al., 1999). These authors reported that French adults seem to focus on the experience of eating, whereas American adults focus more on the consequences of eating. These authors emphasized that the pleasure orientation towards food and the minor role of health considerations were probably important factors in the explanation of the French paradox (i.e., overweight and obesity are less prevalent in France despite the comparable fat intakes in France and the United States). A substantial challenge would be to extend this research involving children from different cultures using both implicit pairing tasks and explicit categorization tasks to assess the dominances of food attitudes in children from different countries. Indeed, based on the results of Rozin and colleagues, one could expect that American children would report more nutritional associations in the implicit pairing task compared with French children, whereas a dominance of cognitively driven attitudes could be expected in American children relative to the French children in the categorization task from an early age. Additional studies are needed to address this question.

Finally, an additional exploratory goal of the present study was to track the potential differences in attitude dominances between the normal-weight and overweight children in the implicit pairing and explicit categorization tasks. Although the number of overweight children was quite low, our preliminary results indicate that the overweight and normal-weight children reported similar percentages of culinary associations in the implicit pairing task. Thus, based on this implicit measure, similar hedonically driven associations were described by both groups. This result can be compared with those observed by Craeynest et al. (2007) who used a personalized implicit IAT and observed similar attitudes in obese and normal-weight children; i.e., both groups of children preferred palatable healthy foods to palatable unhealthy foods. Moreover, in the explicit categorization task of the present study, the overweight children tended to have lower hedonic scores than the normal-weight children. Although only a tendency was observed, one possible interpretation is that the overweight children's categorizations reflected socially normative restrictions that might have led to decreases in experienced pleasure that were elicited by the desire to conform to social/family expectations or simply to diminish cognitive dissonance. Our results are quite different from those of Crayenest et al. (2007) who did not observe a significant difference between obese and normal-weight children in an explicit task. However, the explicit tasks used in these studies were quite different; Craeynest et al. (2007) used a 7-point liking scale (ranging from 'I don't like it a lot' to 'I like it a lot') whereas a categorization task was used in the present study. One possible interpretation is that the obese and normal-weight children's behaviours were more strongly related to wanting than to liking (Stice, Spoor, Bohon, Veldhuizen & Small, 2009), which could explain why no difference was observed in the explicit liking scores in Craeynest's study. In contrast, the categorization task involved a conscious analysis of the potential consequences of the foods in terms of taste-pleasure and nutrition-health considerations. Different explicit attitudes were observed according to weight status only in the categorization task, which makes sense. This finding provides new insight into the attitudes towards foods according to weight status and clearly requires further investigation and replication.

Some methodological points may be discussed. First, the nutritional categories (makes you strong/makes you fat) may not seem to be as oppositely valenced as the hedonic categories (yummy/yucky). The categories 'it makes you fat' and 'it makes you strong' are related to the potential consequences of the foods in term of nutrition-health considerations, which clearly corresponds to the cognitive dimension. In one case ('it makes you strong'), the consequences of eating may be favourable, whereas in the other case ('it makes you fat'), the consequences may be unfavourable. This is why we considered that these two concepts were opposite. Moreover, these categories (makes you strong/fat) were selected because they referred to concrete situations easily conceptualized by young children and easily representable with pictures, contrary to the concepts of "growing, calorie-nutrient, food" vs "empty-calorie food" which are too abstract as shown previously in the literature (Contento, 1981). The pretests indeed showed that none of children spontaneously evoked answers such as 'good for health' or 'bad for health', but chose concrete answers (makes you fat, makes you strong).

In other respects, one may wonder whether the tasks were easily understood with children of all ages. During the pretest, the verbatim of the children were recorded after each association in the pairing task to check the motivations underlying each association. The qualitative analysis showed that the associations were indeed based on nutritional ('there are vegetable') or culinary ('I prefer pasta with sauce') motivations; except for some triplets for which associations were justified by criteria based on the shape and/or on the colour of the foods (i.e. cucumber-zucchinis 'there have the same shape'). To avoid any confusion, these triplets were excluded from the version of the pairing test reported here. Concerning the categorization task, all the food pictures as well as the pictures of the target categories were pre-tested to ensure that they were highly identifiable by children. No negative comment or question emerged from the pre-test, whatever the age group.

### 4.1. Limitations and strengths

Some potential limitations related to our study should be noted. The first is related to the adaptations of the two tasks for use in other countries. Indeed, the food pictures used in our tasks were culturally adapted for French children (for instance, the food "baguette" —white bread-is very common in the French culture, but poorly generalizable in other countries). Therefore, it would be necessary to test other food pictures that are better suited to children from different countries/cultures. Another limitation is that the present study was based on a cross-sectional design; thus, the attitudes towards food could only be described at a specific developmental point. Longitudinal studies are needed to better assess the dynamics of attitude formation through children's development and weight trajectories. Finally, another limitation is the low number of overweight children. Although some differences in the food attitudes of the normal and overweight children were observed in the explicit categorization task, the results clearly requires further investigations involving larger samples of participants. Despite these limitations, the present study provides new insight into children's attitudes towards food according to school level and weight status and describes a new tool that will be easy to implement in large-scale and epidemiological studies.

## 5. Conclusion

This study investigated the food attitudes of children in three school levels using an implicit pairing task and an explicit forced-choice categorization task. The results of the pairing task revealed that hedonically driven attitudes are established quite early, which emphasizes the importance of the pleasure of eating in French culture (Rigal, 2010; Rozin et al., 1999). In contrast, the results of the categorization task revealed that nutritional categorization increased with age at the expense of affective/hedonic answers. These results calls into question the relevance of public health campaigns that are exclusively based on nutritional information and do not account for the pleasure of eating in young children. Finally, the use of tasks from cognitive science can enable both a better understanding of children's attitudes towards food and the development of new evaluative methodologies.

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# Article 2

**Comparison of implicit and explicit attitudes towards food between normal- and overweight French children.**

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## OBJECTIFS & PRINCIPAUX RESULTATS

L'objectif de l'**Article 2** était d'étudier la dominance relative des bases hédoniques et nutritionnelles des attitudes implicites et explicites envers l'alimentation en fonction du statut pondéral des enfants (normo-pondéraux ou en surpoids).

Nous n'avons pas mis en évidence de différence en fonction du statut pondéral concernant la dominance relative des bases hédoniques et nutritionnelles des attitudes implicites. En revanche, les attitudes explicites des enfants en surpoids étaient significativement plus basées sur la nutrition et la santé que les attitudes explicites des enfants normo-pondéraux.

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# Comparison of implicit and explicit attitudes towards food between normal- and overweight French children

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ABSTRACT

In the food domain, attitudes reflect one's acquired predisposition towards food and combine hedonic and nutritional components. Implicit attitudes are assumed to influence spontaneous behaviors, whereas explicit attitudes are assumed to influence deliberative behaviors. The aim of this study was to compare hedonic- versus nutrition-based attitudes towards food between normal- and overweight children using both implicit and explicit tasks. Normal-weight (n = 81; mean BMI z-score = 0.06 ± 0.97) and overweight children (n = 57; mean BMI z-score = 3.5 ± 1.17) performed three tasks: an implicit pairing task in which they had to choose the two food items that "go best together" for 11 triplets that were either hedonically or nutritionally associated; an explicit forced-choice categorization task in which they were asked to categorize 48 foods into one of the following four categories: "yummy", "yucky" (i.e., hedonic categories), "makes you strong", or "makes you fat" (i.e., nutritional categories); a liking task in which they had to assign liking scores to the same 48 food items. No effect of weight status on the liking scores by food groups (all $P > 0.44$) or on the implicit pairing task ($P = 0.82$) were found; however, on the explicit categorization task, overweight children chose more nutritional categories than their lean peers ($P = 0.001$). Cluster analysis showed higher proportion of "*dissonant attitudinal pattern*" (characterized by many hedonic pairings but few hedonic categorizations) in overweight compared with normal-weight children. Thus, a discrepancy between implicit hedonic and explicit nutritional attitudes is more common in overweight children than in normal-weight children. Further studies are needed to understand the behavioral implications of such discrepancy in attitudes towards food in children.

## 1. Introduction

The high prevalence rates of overweight and obesity among children currently represents a public health issue (Bellisle et al., 2007). Indeed, the persistence of overweight into adulthood has been observed in several longitudinal studies (Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008) and has been associated with major health risks (Dietz, 1998). Early deleterious eating behaviors (e.g., eating in the absence of hunger, poor caloric compensation, external eating, emotional eating) have been associated with overweight in children (Carnell, Benson, Pryor, & Driggin, 2013). Nonetheless, the individual factors that are likely to drive such differences in eating behaviors remain unclear. It has been shown that children's food choices are largely driven by taste preferences and liking (Anliker, Bartoshuk, Ferris, & Hooks, 1991; Bere & Klepp, 2004; Birch, 1999; Pliner & Pelchat, 1986; Raynor, Polley, Wing, & Jeffery, 2004). Hill et al. investigated whether children's adiposity was associated with a higher liking of foods thought to be involved in the development of obesity (fatty or sugary foods) and a lower liking of foods thought to be protective (fruit and vegetables) (Hill, Wardle, & Cooke, 2009). They did not find any association, and they suggested that differences in eating behaviors between normal- and overweight children are not driven by a heightened liking of unhealthy foods or a decreased liking of healthy items.

The aim of the present study was to explore the potential differences in the dominance of the nutritional (i.e., cognitive) versus the hedonic (i.e., affective) base of both implicit and explicit attitudes towards food between normal- and overweight children. We assume that whether a child explicitly likes a food might represent only one aspect of the child's drive to eat. A more global approach consists of exploring

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attitudes towards foods. We briefly review the literature on implicit and explicit attitudes towards food in the next part.

### 1.1. Conceptual background

#### 1.1.1. Implicit and explicit attitudes towards food

Attitudes are described as memory structures that are activated when an object is encountered, and reflect one's acquired predisposition towards this object (Eagly & Chaiken, 1998). Attitudes towards a given object can be implicit or explicit and can coexist in memory (Perugini, 2005). Implicit attitudes are assumed to influence responses described as automatic, spontaneous, or uncontrolled, whereas explicit attitudes are assumed to influence responses described as non-automatic, deliberative, or controlled (Perugini, 2005). Implicit and explicit attitudes and how they predict behavior have been largely studied separately. Few attempts have been made to develop predictive models combining the measure of implicit and explicit attitudes and their impact on behavior (Fazio & Olson, 2003; Strack & Deutsch, 2004; Wilson, Lindsey, & Schooler, 2000). In particular, Wilson et al. presented a model of "*dual attitudes*", according to which they hypothesized that "the attitude that people endorse at any point in time depends on whether they have the cognitive capacity to retrieve the explicit attitude and whether this overrides the implicit one" (Wilson et al., 2000). Their predictive model was supported in a food-choice context (Perugini, 2005). This highlights the importance of combining implicit and explicit measures of attitudes towards food in order to better understand eating behaviors under different conditions.

#### 1.1.2. The affective and cognitive bases of explicit and implicit attitudes towards food

Besides its implicit or explicit nature, an attitude combines a cognitive and an affective component, which can be differentially assessed (Crites, Fabrigar, & Petty, 1994; Millar & Tesser, 1986, 1989). Research on explicit attitudes in the food domain has made the following conceptual distinction between the affective and cognitive bases of attitudes: the affective component pertains to the sensations, feelings and emotions experienced in response to a food item (e.g., the hedonic tone of consumption), while the cognitive component encompasses the positive and negative attributes and beliefs about a food item (e.g., nutritional value, health consequences) (Cantin & Dubé, 1999; Dubé & Cantin, 2000). Whether attitudes are affect-based or cognition-based has been shown to influence both liking and consumption of a beverage (Cantin & Dubé, 1999), and to modulate the persuasive power of informational vs. emotional communication promoting milk consumption (Dubé & Cantin, 2000). Regarding research on implicit attitudes in the food domain, the distinction between affective and cognitive bases has been made quite recently on the grounds of research on explicit attitudes towards food. The affective component of an implicit attitude towards food corresponds to the automatic hedonic reactions to a food item (e.g., spontaneous anticipated liking), and the cognitive component contains the automatic beliefs about a food item (e.g., spontaneous perceived healthiness, dieting effect) (Trendel & Werle, 2015). So far, only one study has distinguished the affective and cognitive bases of implicit attitudes towards food to predict eating behaviors (Trendel & Werle, 2015). The authors found that the affective and cognitive bases of implicit attitudes directly influence actual food choices under different conditions. Importantly, the relative dominance of affective or cognitive bases of attitudes towards a food item has been shown to impact behavior (Dubé & Cantin, 2000; Millar & Millar, 1990). Indeed, affective and cognitive attitudes towards food – either explicit or implicit – often do not have the same evaluative consequences. For instance, one could have a positive affective attitudes towards chips because it is tasty, and a negative cognitive attitude because it is unhealthy.

#### 1.1.3. The role of the explicit and implicit attitudes towards food in eating behaviors

As discussed by Perugini, both explicit and implicit attitudes are assumed to influence behavior according to different predictive models (Perugini, 2005). Notably, the author demonstrated that the "double dissociation" predictive model of Wilson et al., according to which implicit attitudes are assumed to influence spontaneous responses, and explicit attitudes are expected to influence deliberative responses, is supported for predicting eating behaviors (Perugini, 2005; Wilson et al., 2000). The fact that the implicit or the explicit attitude is retrieved towards a food can be influenced by individual characteristics, such as being spontaneous versus thoughtful and reflective (Conner, Perugini, O'Gorman, Ayres, & Prestwich, 2007), or being impulsive or not (Friese, Hofmann, & Wänke, 2008). It has also been showed that the number of food choice options could impact the relationship between implicit and explicit attitudes and food choice (König, Giese, Schupp, & Renner, 2016). Interestingly, in the study of König et al., the authors found a significant interaction between the effect of implicit and explicit attitudes on food choices: participants served themselves a greater amount of confectionery compared to fruit when implicit and explicit attitudes indicated a preference for confectionery over fruit, and also when explicit and implicit attitudes towards confectionery were inconsistent and one was positive (König et al., 2016). These results suggest a shift from the "double dissociation" (Wilson et al., 2000) to the "multiplicative" predictive model (Strack & Deutsch, 2004), according to which implicit and explicit attitudes interact in influencing behavior, when multiple food options are offered. However, in the study of König et al., the scale measuring explicit attitudes only took into account affective considerations, namely tasty vs. not tasty, good vs. bad and appealing vs. unappealing but no cognitive consideration, such as healthy vs. unhealthy (König et al., 2016). Such explicit nutritional considerations could have influenced food choices but are not taken into account in their measure of explicit attitudes. Thus, these results have to be interpreted cautiously.

### 1.2. Scope of the present research: comparing normal- and overweight children's attitudes towards food

Previous attempts to investigate implicit and explicit attitudes towards food in obesity only focused on the evaluative aspect of attitudes (i.e., whether a certain food is viewed positively or negatively) without dissociating the affective and cognitive components of attitudes (Craeynest et al., 2005; Czyzewska & Graham, 2008; Roefs & Jansen, 2002). Specifically in children, Craeynest et al. investigated the positive vs. negative valence of explicit and implicit attitudes towards healthy and unhealthy food in normal- and overweight children (Craeynest et al., 2005). Their results revealed no differences between normal- and overweight children in their explicit attitude towards food. They also found that overweight children had a more positive implicit attitude towards both healthy and unhealthy foods. However, their approach reduced the explicit attitudes towards food to their affective basis: children rated the valence of healthy and unhealthy foods using a 7-point scale (−3: dislike; +3: like), and did not permit untangling whether a positive implicit attitude towards food was hedonic-based (e.g., "I like this food") or nutrition-based (e.g., "This food is healthy").

Exploring the hedonic versus the nutritional aspect of attitudes towards food is a complementary approach to previous investigations of attitudes towards food in normal- and overweight children. There are consistent evidence that normal- and overweight children do not differ on the valence of the affective basis of explicit attitudes (i.e., the liking for food) (Craeynest et al., 2005; Hill et al., 2009). In other respects, overweight children are known to declare themselves as more restrained than normal-weight children (for a review see Carnell et al., 2013) which may reflect cognitive-based explicit attitudes towards food. Thus, explicit attitudes could be more nutrition-based in overweight than in normal-weight children. Regarding the implicit atti-

tudes, it has been shown in adults that their valence was significantly positively correlated with the explicit measure of palatability (Ayres, Conner, Prestwich, & Smith, 2012). The authors did not provide information about the weight status or the dieting status of their participants but we can assume that the sample was mostly constituted of normal-weight adults. On the contrary, another study comparing attitudes of normal-weight and obese adults highlighted a significant correlation between implicit attitudes towards high fat food and the explicit attitude "I should not eat high-fat food", but no relationship between implicit attitudes and palatability (Roefs & Jansen, 2002). In this study, half of the sample was obese. Together, these two studies suggest that implicit attitudes might reflect palatability (i.e., affective considerations) in normal-weight people but restriction (i.e., cognitive considerations) in overweight people (Ayres et al., 2012; Roefs & Jansen, 2002). Thus, implicit attitudes of overweight people could be less hedonic-based, and more nutrition-based, than implicit attitudes of normal-weight people.

In a previous study (Monnery-Patris, Marty, Bayer, Nicklaus, & Chambaron, 2016), we investigated the dominance of nutritional versus hedonic basis of implicit and explicit attitudes towards food in school-aged children's in a developmental perspective. To do that, an implicit and an explicit task were developed. A pairing task was used to assess implicit attitudes. Children were asked to select two foods from three (e.g., steak, chicken, and French fries) that they though fit well together. No criteria for selection were given, which enabled us to explore in an implicit way the types of pairings (nutritional or hedonic) spontaneously performed by children. A categorization task was used to assess explicit attitudes. Children were asked to categorize pictures of foods in a 4-alternative forced-choice procedure ("makes you strong", "makes you fat", "yucky" and "yummy"). This task involved explicit analysis of the potential benefits of the foods from either a nutritional ("makes you strong", "makes you fat") or a hedonic perspective ("yucky", "yummy"). For both tasks, for each trial, children had to choose between an affective-based answer and a cognitive-based answer. It was assumed that the proportion of affective and cognitive answers would reflect the relative dominance of the affective or cognitive basis of implicit and explicit attitudes respectively. To assess the dynamics of attitude dominance (i.e., hedonic- or nutrition-based) through development, 3 school levels were considered (corresponding to 5-, 8- and 10-year-olds). The results revealed an increase in implicit hedonic-based attitudes but a decrease in explicit hedonic-based attitudes with school level. This demonstrates that cognitive development plays a role in determining implicit and explicit children's attitudes towards food.

In the present study, we explored the potential differences in the dominance of the nutritional (i.e., cognitive) versus the hedonic (i.e., affective) base of implicit and explicit attitudes towards food between normal- and overweight children using the same method as Monnery-Patris et al. (2016). A liking task was also included. According to Hill et al., we hypothesized that normal- and overweight children would not differ in their liking of particular foods (Hill et al., 2009), but may differ in their implicit and explicit attitudes towards food (hedonic- vs. nutritional-based). Based on previous literature in children and in adults, we hypothesized that overweight children might have more nutrition-based implicit and explicit attitudes towards food than normal-weight children. Taking into account previous results on the influence of cognitive development on implicit and explicit children's attitudes towards food, children's school levels were also included in the analyses. Furthermore, the relationship between implicit and explicit attitudes was investigated to describe attitudinal patterns according to weight status; behavioral implications of these attitudinal patterns are discussed.

## 2. Material and methods

### 2.1. Ethics

The study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethical committee (Comité pour la Protection des Personnes EST-1 Burgundy, file number: 2015-A00017-42). Written informed consent was obtained from parents before their child's participation in the study. We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were adhered to during this research study.

### 2.2. Participants

To be included in the study children had to be attending an elementary school. Overweight children were recruited during pediatric weight care consultations at a public hospital between March and July 2015. Moreover, two elementary schools in Eastern France were selected to access a population of children from different socio-economic backgrounds. The families of all children in the two selected elementary schools were contacted in June 2015. A power calculation based on a previous study (Monnery-Patris et al., 2016) indicated that a minimal sample size of 90 participants (45 overweight and 45 normal-weight children) would be needed to detect a significant difference in attitudinal scores (difference ± SD: 13 ± 22%) across two groups, with an 80% power at $\alpha = 0.05$.

### 2.3. Procedure

The children participated in one experimental session that involved three tasks: a pairing task, a forced-choice categorization task, and a liking task, presented in this order. The children were provided with touch-screen tablet and headphones for hearing the instructions. They were tested individually or in small groups (max. 9 children watched by 2 interviewers). The tasks were self-administered in a quiet room at the hospital or in their school. An experienced interviewer was present to give the initial instructions and was available for consultation if needed. The interviewers forbade interactions between children during the experimental session.

### 2.4. Material

#### 2.4.1. Implicit pairing task

The implicit pairing task was initially developed and validated by Monnery-Patris et al. (2016). This task was inspired by the original food culinary pairing task of Rozin, Fishler, Imada, Sarubin, and Wrzesniewski (1999), which measures whether a participant associates a food term preferentially with a culinary term (e.g., bread–butter) or with a nutritional term (e.g., bread–carbohydrate) by having the participant circle the word that he/she believes is the most different from the other two. In the adapted version of the pairing task for children, pictures of foods were included, and the instructions were changed to "choose the 2 foods that go best together" among food triplets (e.g., steak, chicken, and French fries). Thus, a child could perform a hedonic association by pairing two food items that are typically consumed together (e.g., steak with French fries or chicken with French fries) or a nutritional association by pairing the two nutritionally similar food items (e.g., steak with chicken because they both belong to the meat category). No criteria for selection were given with the goal of recording the nature of the pairings (hedonic or nutritional) that were spontaneously made by the children. To confirm the validity of the measures, a pre-test with 27 children was initially performed to ensure that only highly identifiable foods (> 95%) were included in the task, and to examine children's understandings of the instructions (Monnery-Patris et al., 2016). The verbatim of the children

were recorded by an experimenter after each association in the pairing task to check the attitudinal motivations underlying each association. In other words, it was expected that an association such as steak-chicken (coded as nutritional association) would be justified by nutritional considerations (for example, “they are both meat”), and that an association such as chicken-French fries (coded as hedonic association) would be motivated by hedonic considerations (for example, “I like eating chicken with French fries”). The results of the qualitative analysis of children’s verbatim lead to the conclusion that nutritional or hedonic pairings were congruently justified by nutritional or culinary justifications respectively for most of the triplets. Triplets involving associations justified by criteria based on the shape or on the color of the foods were excluded from the test. This kind of visual associations were marginal.

Finally, eleven triplets of food-item pictures were successively presented, including an initial training triplet (strawberry, raspberry and whipped cream) followed by 10 test triplets (chicken, steak and French fries; baguette bread, butter and Nutella; tomatoes, olive oil and mayonnaise; cigarette cookies, chocolate chip cookies and applesauce; white bread, baguette bread and jam; waffle, pancakes and jam; plain cookies, chocolate chip cookies and applesauce; chicken, French fries and potato wedges; fruit salad, cigarette cookies and applesauce; pasta, rice and steak) presented in a randomized order (Monnery-Patris et al., 2016). The instructions and names of each food item were orally provided via the tablet computer when the food pictures appeared on the screen. For each triplet, the children gave their answers by touching on the screen the 2 pictures of the foods that they thought fit well together; this action was recorded by the program. No feedback was given. The pairing task required approximately 5 min.

#### 2.4.2. Explicit forced-choice categorization task

The forced-choice categorization task was initially developed and validated by Monnery-Patris et al. (2016). This task was inspired by Berger's analyses of children’s categorization tools (Berger, 1997) and adapted to the study of the cognitive vs. affective dimensions of food attitudes. Fifty-one pictures of highly identifiable foods (for at least 95% of children) were selected based on a previous pretest with 27 children as described in the “implicit pairing task” section. The selected food item pictures were successively presented, including 3 for initial training (a banana, a lollipop, and rice) followed by 48 randomized test food-item pictures: 9 fruits (an apple, grapefruit, an orange, melon, grapes, a pear, a kiwi, a nectarine, and fruit salad) and 10 vegetables (tomatoes, shredded carrots, cucumber, string beans, peas, vegetable soup, zucchini, mixed vegetables, ratatouille and lentils) that were aggregated in the “fruit and vegetables” group; 6 animal protein dishes (fish fillet, salmon steak, beefsteak, lamb chop, a fried egg, and an omelet) aggregated in the “meat, fish and eggs” group; 4 cheeses (gruyere, camembert, roquefort, and goat cheese) aggregated in the “cheese” group; and 4 high-fat dishes (a hamburger, lasagna, pizza, and French fries), 3 salted snacks (chips, pretzels, and small quiche), 5 sweet snacks (croissant, plain cookies, candies, chocolate, and a candy bar), and 7 desserts (a chocolate éclair, a strawberry ice-lolly, a crème caramel, an ice cream, apple pie, chocolate cake, and chocolate pudding) were aggregated in the “foods high in fat, salt and sugar” group (Monnery-Patris et al., 2016).

The children were asked to choose whether each food item was “yummy” (“*c'est miam*” in French) or “yucky” (“*c'est beurk*”), both grouped in the hedonic dimension, or whether it “makes you strong” (“*ça donne des forces*”) or “makes you fat” (“*ça fait grossir*”), both grouped in the nutritional dimension. Another category, “I don’t know this food”, was also available. The corresponding meaning of each pictogram was provided for the 3 first food items. The choices were represented by pictures that were initially pre-tested to ensure that they reflected what they were supposed to represent (Monnery-Patris et al., 2016). Children were presented with different pictures (smileys, picture of characters; etc.) supposed to reflect the different categories (“yummy”, “yucky”, “makes you strong”, “makes you fat”, “I don’t know this food”). Children were asked to describe what each picture was supposed to represent. Finally, pictures that were correctly labelled for the purpose of the study at least in 95% of the cases were selected. These categories (“makes you strong” vs “makes you fat”) were selected because they referred to concrete situations easily conceptualized by young children and easily representable with pictures, contrary to the concepts of “good for health” vs “bad for health” which are too abstract as shown previously in the literature (Contento, 1981). The pretest indeed showed that none of children spontaneously evoked answers such as ‘good for health’ or ‘bad for health’, but chose concrete answers (makes you fat, makes you strong).

The instructions and the name of each food item were orally provided by the tablet computer. The children provided their answer by touching on the screen one of the 5 category pictures, which was recorded by the program. No feedback was given. This task required approximately 10–15 min.

#### 2.4.3. Liking task

This task required the children to assign liking scores for the 48 food items used in the forced-choice categorization task. A continuous scale with a red point in the middle appeared on the screen. Above was a neutral smiley face that could progressively “smile” as the red point was moved to the right or progressively “grimace” as the red point was moved to the left. This scale was inspired by Yuan et al., who first developed a liking measure task on a continuous scale (Yuan et al., 2016). The children were asked to indicate how much they liked the food item they saw on the screen by moving the red point along the scale. Foods the children had never tried were not rated for liking. The instructions and the name of each food item were orally provided by the touch-screen tablet. No feedback was given. This task required approximately 10–15 min.

### 2.5. Children’s anthropometrics

Trained medical doctors or trained researchers measured weight and height. Weight (kg) was measured with the child wearing light clothes and no shoes to the nearest 0.1 kg using a digital scale (Soehnle, Benfeld, Germany); height (cm) was measured to the nearest 0.1 cm with the child in a standing position without shoes using a stadiometer (Seca Leicester, Birmingham, UK). Body mass index (BMI) was calculated and transformed into age- and sex-standardized z-scores (z-BMI) based on the French reference data (Rolland-Cachera et al., 1991). Children were considered overweight if z-BMI $\geq$ 2.

### 2.6. Data management and statistical method

A hedonic pairing score (resp. a nutritional pairing score), based on the percentage of hedonic associations (resp. nutritional associations), was calculated for each child (range: 0–100%). This score was hypothesized to reflect an implicit hedonic-based (resp. nutrition-based) attitude towards food. A hedonic categorization score (resp. a nutritional categorization score), based on the percentage of hedonic answers (resp. nutritional answers) for known foods, was calculated for each child (range: 0–100%). This score was hypothesized to reflect an explicit hedonic-based (resp. nutrition-based) attitude towards food. The liking scores for each food item were coded from 0 to 10. The liking scores for the food groups was the average of the individual liking scores of the items in the group, in line with previous studies (Breen, Plomin, & Wardle, 2006; Cooke & Wardle, 2005; Cooke et al., 2011; Hill et al., 2009). The children were grouped according to their school grade level, as follows: school level 1 corresponded to the two first grades of elementary school, and school level 2 corresponded to the three last grades of elementary school. School level was used in the analyses instead of age because it reflects children’s cognitive development in a larger extend.

ANOVAs were performed to test the effect of weight status and school level and their interaction on the pairing scores, categorization scores and the liking scores by food groups. Additionally, a hierarchical cluster analysis (HCA) was performed on the hedonic pairing and categorization scores to explore attitudinal patterns towards food. To select the number of clusters yielded by the HCA, we computed the root-mean-square standard deviation for each level of the cluster analysis. We selected the number of clusters corresponding to the largest difference between two consecutive levels (Milligan & Cooper, 1985). On this basis, three clusters were selected: a first cluster with hedonic pairing scores above 50 and hedonic categorization scores above 60; a second cluster with hedonic pairing scores above 50 and hedonic categorization scores below 60; and a third cluster with hedonic pairing scores below 50.

The statistical analyses were performed using SAS software version 9.3 (SAS Institute, Inc., 2012 SAS® 9.3. Cary, NC: SAS Institute Inc.). Significance was set at $P = 0.05$. The results are expressed as the mean ± SEM.

## 3. Results

### 3.1. Sample characteristics

One hundred thirty-eight children were recruited (Table 1). The children from school level 1 were aged 7.5 ± 0.10 years (min: 6.1 years, max: 9.8 years, n = 53), and 18 were overweight (mean z-BMI of overweight children: 4.02 ± 0.33, normal-weight children: 0.15 ± 0.18). The children from school level 2 were aged 10.1 ± 0.10 years (min: 8.3 years, max: 12.3 years, n = 85), and 39 were overweight (mean z-BMI of overweight children: 3.27 ± 0.16, normal-weight children: 0.00 ± 0.14). No influence of recruitment place on either liking or hedonic pairing or categorization scores was observed (all $P > 0.15$); the data were pooled.

### 3.2. Liking task

The liking ratings of normal- and overweight children for the included food groups are described Fig. 1. For the fruit and vegetables group, an ANOVA revealed no effect of weight status [F(1, 134) = 0.16, $P = 0.69$], no effect of school level [F(1, 134) = 0.44, $P = 0.51$] and no effect of the interaction [F(1, 134) = 0.96, $P = 0.33$] on liking scores. For the foods high in fat, salt and sugar group, an ANOVA revealed no effect of weight status [F(1, 134) = 0.59, $P = 0.44$], no effect of school level [F(1, 134) = 1.10, $P = 0.30$] and no effect of the interaction [F(1, 134) = 0.15, $P = 0.70$] on liking scores. For the meat, fish and eggs group, an ANOVA revealed no effect of weight status [F(1, 134) = 0.00, $P = 0.97$], no effect of school level [F(1, 134) = 0.09, $P = 0.77$] and no effect of the interaction [F(1, 134) = 1.49, $P = 0.22$] on liking scores. For the cheeses group, an ANOVA revealed no effect of weight status [F(1, 134) = 0.23, $P = 0.64$], no effect of school level [F(1, 134) = 0.99, $P = 0.32$] and no effect of the interaction [F(1, 134) = 0.26, $P = 0.61$] on liking scores.

**Table 1**
Participant characteristics.

| | All (n = 138) | Normal-weight (n = 81) | Overweight (n = 57) | *P* |
|---|---|---|---|---|
| Age[a] | 9.1 ± 1.54 | 9.0 ± 1.58 | 9.2 ± 1.47 | 0.35[b] |
| Gender (% girls) | 56% | 57% | 54% | 0.78[c] |
| z-BMI[a] | 1.48 ± 2.00 | 0.06 ± 0.97 | 3.5 ± 1.17 | < 0.0001[b] |
| School level | | | | 0.17[c] |
| School level 1 | 38% | 43% | 32% | |
| School level 2 | 62% | 57% | 68% | |
| Recruitment place | | | | < 0.0001[c] |
| School | 68% | 95% | 30% | |
| Public hospital | 32% | 5% | 70% | |

*Abbreviations:* z-BMI, body mass index z-score.
[a] Values are means ± SEM.
[b] *T*-test.
[c] Chi-square test.

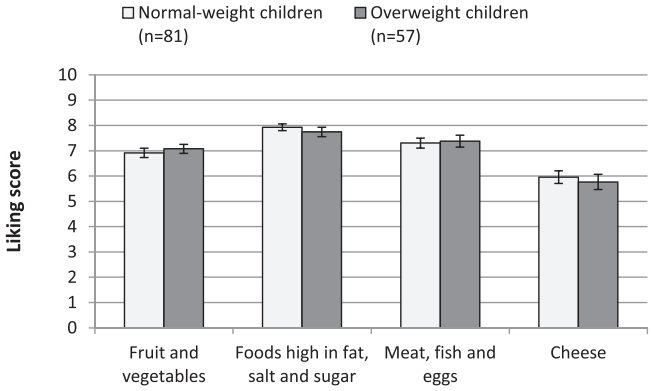


**Fig. 1.** Mean liking scores ( ± SEM) by food groups in normal- and overweight children.

### 3.3. Pairing and forced-choice categorization tasks

The hedonic and nutritional scores of normal- and overweight children for both tasks are described Fig. 2. An ANOVA revealed no effect of weight status [F(1, 134) = 0.05, $P = 0.82$], a significant effect of school level [F(1, 134) = 5.29, $P = 0.02$] – the hedonic pairing score increased with school level – and a marginally significant school level × weight status interaction [F(1, 134) = 5.79, $P = 0.052$] on hedonic pairing scores. An ANOVA revealed a significant effect of weight status [F(1, 134) = 10.82, $P = 0.001$] and school level on hedonic categorization scores [F(1, 134) = 11.02, $P = 0.001$] but no effect of the school level × weight status interaction [F(1, 134) = 0.95, $P = 0.33$]. Since the hedonic scores and the nutritional scores are linked by the following equation: *nutritional score = 100 − hedonic score*, the ANOVAs on the nutritional scores are not reported.

Additional analysis showed that overweight children chose more both nutritional categories than normal-weight children but in a higher extend for the "makes you fat" category (percentage of choice of the "makes you fat" category by normal-weight children: 14.5 ± 1.09%, overweight children: 25.1 ± 1.85%, t(136) = −5.22, $P < 0.001$; percentage of choice of the "makes you strong" category by normal-weight children: 20.9 ± 1.79%, overweight children: 26.3 ± 2.04%, t(136) = −1.94, $P = 0.054$). On the contrary, overweight children

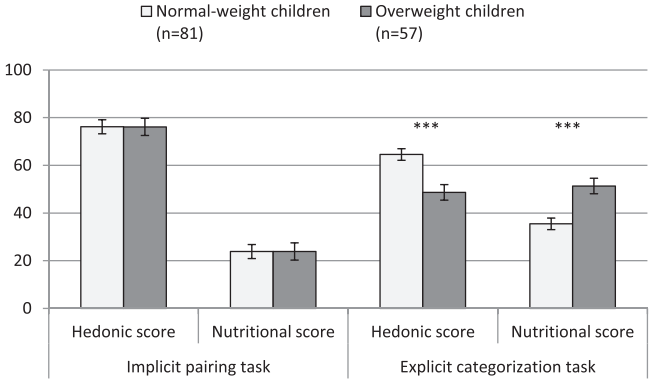


**Fig. 2.** Mean hedonic and nutritional scores ( ± SEM) for the implicit pairing and explicit forced-choice categorization in normal- and overweight children. Group differences were assessed by using ANOVA after control for school level: $^{***}P = 0.001$.

chose less the two hedonic categories than normal-weight children (percentage of choice of the "yummy" category by normal-weight children: 46.6 ± 2.13%, overweight children: 35.2 ± 2.88%, t(136) = 3.24, $P = 0.002$; percentage of choice of the "yucky" category by normal-weight children: 18.0 ± 1.24%, overweight children: 13.4 ± 1.25%, t(136) = 2.50, $P = 0.01$). Besides, additional analysis by food groups showed that the highest hedonic categorization score was obtained for the cheese group (76.1 ± 2.54%), followed by the meat, fish and eggs group (64.0 ± 2.64%), then the fruit and vegetables group (57.4 ± 2.38), and finally the foods high in fat, salt and sugar group (53.0 ± 2.45%). The most important difference between normal- and overweight children's hedonic categorization score by food group was found for the foods high in fat, salt and sugar group (normal-weight children: 61.8 ± 2.86%, overweight children: 40.5 ± 3.76%, t(136) = 4.09, $P < 0.001$), followed by the fruit and vegetables group (normal-weight children: 63.3 ± 2.95%, overweight children: 49.0 ± 3.69%, t(136) = 3.05, $P = 0.003$), then the meat, fish and eggs group (normal-weight children: 68.9 ± 3.16%, overweight children: 57.0 ± 4.42%, t(136) = 2.24, $P = 0.03$), but no difference was found for the cheese group (normal-weight children: 76.5 ± 3.18%, overweight children: 75.4 ± 4.22%, t(136) = 0.21, $P = 0.83$).

### 3.4. Attitudinal patterns

Based on the exploration of the data using an HCA of the hedonic pairing and categorization scores, we identified three patterns of children. The *hedonist pattern*, characterized by high hedonic scores both on the pairing task (≥50%) and the categorization task (≥60%), was observed for 57 children (41% of the sample). The *dissonant pattern*, characterized by a high hedonic pairing score (≥50%) and a low hedonic categorization score (< 60%), was observed for 66 children (48%). The *nutrition-focused pattern*, characterized by a low hedonic pairing score (< 50%), was observed for 15 children (11%). The patterns broken down according to the normal weight and overweight groups were as follows: 53% of the normal-weight children fit the hedonist pattern, 37% fit the dissonant pattern and 10% fit the nutrition-focused pattern; 25% of the overweight children fit the hedonist pattern, 63% fit the dissonant pattern, and 12% fit the nutrition-focused pattern. Weight status and attitudinal patterns were not independent (chi-square test: $P = 0.0031$).

## 4. Discussion

To the best of our knowledge, this is the first study to investigate hedonic- versus nutrition-based attitudes towards food in normal- and overweight children using both implicit and explicit tasks. As a first step, we showed that there was no difference in liking across weight status for any food group. The pairing task showed that the overweight children were implicitly as hedonistic as normal-weight children, and the forced-choice categorization task indicated that they were explicitly more nutrition-focused than normal-weight children. Moreover, combining the hedonic implicit and explicit scores helped to identify three attitudinal patterns (hedonist, dissonant, nutrition-focused) that were represented in both weight status groups, with a higher proportion of the overweight children fitting the dissonant pattern and a higher proportion of the normal-weight children fitting the hedonist pattern.

As expected, no difference in liking of foods was found between normal-weight and overweight children for any food group. These findings support the results of a British sample of 7- to 9-year-old children (Hill et al., 2009). The authors did not find any association between adiposity and liking fatty or sugary foods, fruits or vegetables. We confirmed these results, and also showed that there was no difference in liking eggs, meat, fish or cheese. Two other studies of adolescents showed no difference in food liking between groups with varying weight status (Diehl, 1999; Perl, Mandić, Primorac, Klapec, & Perl, 1998). We assume that a more global approach, notably the investigation of implicit and explicit attitudes towards food, may be more relevant than how much a food is explicitly liked to understanding how normal-weight and overweight children differ in their drive to eat.

The implicit pairing task aimed to explore the dominance of hedonic or nutritional associations when no criteria were given. This task was thought to access implicit attitudes towards food, defined as automatic and spontaneous (Wilson et al., 2000). Contrary to our hypothesis based on previous studies in adults (Ayres et al., 2012; Roefs & Jansen, 2002), we did not find any significant effect of weight status on the implicit hedonic pairing score. The implicit pairing task used in this study has never been used before to assess implicit attitudes towards food which could explain the difference between what was observed here and what could have been expected based on previous studies. Moreover, our hypothesis was based on research in adults and it may be assumed that the conclusions from the study of attitudes towards food in adults are not directly generalizable to children. A significant increase with increased school level was observed, in line with previous results (Monnery-Patris et al., 2016). The fact that the implicit hedonic pairing score increased with school level reveals that the implicit pairing task may capture the integration and appropriation of culinary scripts and cultural learning. This is in line with a previous interpretation of implicit attitudes measured with other paradigms, such as the Implicit Association Test (IAT) (Greenwald, McGhee, & Schwartz, 1998). Implicit attitudes are hypothesized to result from associative reasoning and to reflect an individual's level of exposure to a given association in his/her cultural environment (Greenwald et al., 2002; Karpinski & Hilton, 2001). In sum, implicit attitudes towards food reflect passive learning through eating experiences. Moreover, the original food pairing task developed by Rozin et al. has been shown to be sensitive to cultural background (Rozin et al., 1999). For instance, these authors reported that the Americans showed a smaller tendency to culinary associations than the French. Here one may infer that normal weight and overweight children involved in the present study had been exposed to similar cultural milieus in terms of types of foods and eating representations. A substantial challenge would be to extend this research involving children from different cultures to assess the dominances of food attitudes in children from different countries. Based on the results of Rozin et al., one could expect that American children would report more nutritional associations in the implicit pairing task compared with French children. Additional studies are needed to address this question.

The explicit forced-choice categorization task aimed to explore the dominance of hedonic or nutritional categorizations when explicit classification criteria were given. This task was thought to access explicit attitudes towards food, defined as non-automatic and deliberative (Wilson et al., 2000). Because this task involved a direct analysis of the potential hedonic or nutritional benefits of food consumption, either hedonic or nutritional, it can be argued that the children's answers to this task were more prone to reflect social norms and familial ideas compared with the answers obtained in the implicit task. To clearly establish the difference in the interpretation of the 2 tasks, we hypothesize that the pairing task could reflect a passive impregnation and appropriation of cultural habits by children, whereas the categorization task could rather reflect an active and intentional inculcation of social norms through education, family expectations or health promotion programs. In line with our hypothesis, significant effect of weight status was found for the hedonic categorization score. We observed that the overweight children had lower hedonic categorization scores than normal-weight children; specifically, we found a dominance of explicit nutrition-based attitudes among overweight children. We hypothesized that overweight children are more exposed to and more concerned about nutritional information. Furthermore, the majority of the overweight children were followed by a pediatrician for weight care. Their nutrition-based answers to the explicit task may have

also resulted from this weight care, which generally emphasizes the nutritional aspects of diets and tends to stigmatize pleasure from food. Consistent with previous results, we also observed a lower percentage of hedonic categorizations among the children at the highest school level (Monnery-Patris et al., 2016). The increase in the percentage of nutritional categorizations with increasing school level may reflect increased exposure to health-promoting messages, greater cognitive development and increased rationality as children grow (Contento, 1981; Contento, Randell, & Basch, 2002). Additional analysis on food groups showed that the foods high in fat, salt and sugar group and the fruit and vegetables group are the ones which elicited the most nutrition-based categorizations, notably among overweight children. This could be explained by the emphasis put on these two food groups by national health campaigns that have extensively broadcasted prevention messages since 2004 in France, such as: "For your health, eat at least 5 fruit and vegetables per day" or "For your health, avoid eating too fatty, too sweet or too salty" (Hercberg, Chat-Yung, & Chauliac, 2008).

### 4.1. Theoretical implications

At first sight, our finding appear to differ from the conclusions of Craeynest et al. (2005). In this study, the authors investigated explicit and implicit attitudes towards healthy and unhealthy foods in normal- and overweight children. They concluded that normal- and overweight children did not differ in their explicit attitudes towards food. As mentioned in the introduction, children's ratings of the valence of healthy and unhealthy foods using a 7-point scale (−3: dislike; +3: like) was assumed to reflect their explicit attitudes. Thus, only the affective basis of explicit attitudes was assessed. This measure is close to the one used to assess liking in the present study, and we did obtain the same conclusion as Craeynest et al.: there was no difference in liking for foods high in fat, salt and sugar and for fruit and vegetables between normal- and overweight children using explicit affective evaluation. We demonstrated here that attitudinal differences between normal- and overweight children can be found in the relative dominance of the affective or cognitive basis of explicit attitudes rather than in the valence of the affective basis of explicit attitudes.

The question of how implicit and explicit attitudes interact arose from the contrasting results obtained according to whether implicit or explicit attitudes were assessed. Three attitudinal patterns of implicit and explicit hedonic scores were identified: the hedonist pattern, characterized by high implicit and explicit hedonic scores; the dissonant pattern, characterized by high implicit hedonic scores but low explicit hedonic scores, i.e., a dissociation of implicit and explicit attitudes; and the nutrition-focused pattern, characterized by a particularly low implicit hedonic score. These three attitudinal patterns may drive different patterns of eating behavior. In line with the conclusions of Perugini (2005), we can hypothesize that both children having a congruent hedonist or a congruent nutrition-focused attitudinal pattern would have the same response to a food, hedonic-based or nutritional-based respectively, either spontaneously or deliberatively. On the contrary, dissonant children would have a spontaneous hedonic-based response, but a deliberative nutritional-based response to a food. Clearly, further research is needed to investigate whether the different attitudinal patterns highlighted here, combining implicit and explicit attitudes and distinguishing their affective and cognitive bases, actually translate into different behaviors under different conditions, in particular in normal-weight and overweight children.

### 4.2. Practical implications

The relationship between attitudinal patterns and weight status is of particular interest. We found the major part of normal-weight children were hedonist (53%) whereas the major part of overweight children were dissonant (63%). For the major part of the normal-weight children, the hedonic basis is dominant for both implicit and explicit attitudes towards food. It seems that children with no reason to worry about their weight primarily consider food as a source of pleasure. It has been shown in a qualitative study that 9–11-year-old French children viewed food as a necessity of life, vital for maintenance of the body and as a pleasure, in order of importance, but they rarely mentioned nutritional concerns (Le Bigot Macaux, 2001). Furthermore, a recent study examined the relative importance of children's explicit perceptions of the taste and healthiness of foods in determining children's food choices (Nguyen, Girgis, & Robinson, 2014). Children were asked to rate presumed taste ("not at all yummy – very yummy") and the healthiness ("not at all healthy – very healthy") of various foods and to indicate whether they would eat these foods in a food selection task. The results showed that presumed taste was a more powerful determinant of whether a food would be selected than its healthiness. These results demonstrate further that hedonism seems to be predominant in normal-weight children's relation to food: they basically want to eat what they like. On the contrary, we observed a high prevalence of the dissonant attitudinal pattern among overweight children. Children with a dissonant pattern are implicitly hedonistic (i.e., they have a spontaneous hedonic-based attitude) and, at the same time, they are explicitly nutrition-focused (i.e., they feel concerned about the nutritional content of foods and their health consequences). This high prevalence of the dissonant attitudinal pattern may have resulted from weight care, which emphasizes the nutritional aspects of diets to encourage children to adopt a healthier diet. At present, there is little evidence that children's explicit awareness of the health consequences of their diet could have a positive impact on the adoption healthier eating behaviors in the long term (for a review see: Whitlock, O'Connor, Williams, Beil, & Lutz, 2010). Furthermore, it has been suggested that the discrepancy between hedonic-based implicit attitudes and nutritional-based explicit attitudes could be a threat to healthy eating behaviors (Goldstein et al., 2013). Indeed, in a study in adults, the discrepancy between implicit and explicit attitudes towards chocolate has been linked to disinhibited eating (Goldstein et al., 2013). The authors assumed that this link could be causal (i.e., the dissociation between implicit and explicit attitudes could predict disinhibited eating), and that it could be explained by the meta- cognitive model, which posits that attitudinal dissociation intensifies focus on the attitude object (e.g., a tempting food) (Petty, 2007). This intensified focus on a food could enhance the temptation, thereby increasing the likelihood of a disinhibited eating episode. Consequently, a dissonant pattern could increase the likelihood of disinhibited eating episodes leading to overeating and weight gain in children (Tanofsky-Kraff et al., 2009). The nutrition-focused attitudinal pattern was found to be marginal in both normal- and overweight children. One could have expected than children with spontaneous nutritional concerns would have make eating decision in the right way. Nonetheless, this attitudinal pattern seems to not be linked with weight status. Considering the weak number of children having this attitudinal pattern (15 children), it is difficult to predict the potential behavioral consequences of this pattern. Further research is needed, including measure of actual eating behavior, to better understand the relationship between the attitudinal patterns previously described and behavior. Finally, we showed that overweight children could be either hedonist, or nutrition-focused, or dissonant; there was not a unique attitudinal pattern for overweight children. Yet, it has been advanced that the effectiveness of health education efforts may depend on the target individual's dominant attitude towards food (affective or cognitive) (Dubé & Cantin, 2000). Thus, it would be relevant to investigate whether weight care strategies might be adapted according to children's attitudinal patterns to improve their effectiveness.

### 4.3. Methodological issues and limitations

Some methodological points may be discussed. Considering the fact

that on average the implicit hedonic score was particularly high (76.2 ± 2.27%), one may wonder whether the pairing task was easily understood by children. In particular, whether the instruction to choose foods that "go best together" is neutral enough to allow both hedonic- and nutrition-based associations? On one hand, the pre-test of the implicit pairing task showed that the associations could be based either on nutritional ("there are meat") or hedonic ("I like to put jam on my waffle") motivations. On the other hand, the fact that the hedonic dimension has been spontaneously predominant relative to the nutrition-related features in this sample of French children is in line with previous work on attitudes towards food in French adults (Rozin et al., 1999). The authors highlighted the importance of pleasure from food as well as the minor role of health consideration related to food in French people. Thus, high implicit hedonic scores could reflect the dominance of food pleasure-oriented associations in children that have previously been reported in French adults (Rozin et al., 1999). Cross-cultural studies are needed to investigate properly the influence of the cultural background on implicit attitudes towards food. The study of attitudinal patterns, combining both implicit and explicit attitudes towards food, showed that although the majority of overweight children were dissonant, this was not the case for all of them. Additionally, although the majority of normal-weight children were hedonist, not all of them were hedonist. Thus, there was not a unique attitudinal pattern associated to normal- or overweight children respectively. These results highlighted the variability of attitudes towards food within weight status groups of children.

Some potential limitations of our study should be noted. The study was conducted both in a hospital, which could easily prime health-oriented answers in children, and at school, a location though more neutral than a hospital but where children could perceive social pressure to give normative answers. We did not find any statistical effect of the place of recruitment on the different measured scores but this does not rule out that the attitudes of children recruited at the hospital may be impacted by pediatric weight care to some extent. Another limitation is that the present study was based on a cross-sectional design; thus, the attitudes towards food could only be described at a specific developmental point. Longitudinal studies are needed to better assess the dynamics of attitude formation through children's development and weight trajectories. Furthermore, the implicit task was conducted with different food items than the explicit categorization task and liking task. This could have influenced the nature of the result obtained with the both tasks. In addition, the three tasks were not presented in a counterbalanced order. The constant order of administration (implicit pairing, explicit categorization, liking task) was chosen to limit experimental bias. The implicit pairing was presented first because spontaneous answers were wanted to reflect implicit attitudes towards food, which could have been biased by the two other tasks. Then we presented the explicit categorization task, and at the end the liking task. Because both the categorization and the liking task included the same stimuli, previous categorizations might have influenced the subsequent liking evaluation. However, presenting the liking task before the explicit categorization would have been worse because asking about liking would have possibly artificially enhanced hedonic categorization of foods. In other respects, in the categorization task, the cognitive categories ("makes you strong" and "makes you fat") refer to a long term effect of food consumption on health whereas the affective categories ("yummy" and "yucky") refer to a short term effect of food consumption on pleasure. The choice of one category among the four involved the choice between immediate versus delayed consequences. Thus, the results of this task might be partly confounded with the degree of impulsivity of the children (Epstein, Dearing, Temple, & Cavanaugh, 2007). Finally, one could argue that the high prevalence of the dissonant pattern was partly related to the nature of the tasks: an implicit task would be more likely to capture the affective components of attitudes (such as hedonic pairings), and an explicit task would be more likely to capture cognitive components (such as nutritional categorizations). Nonetheless, in the theoretical framework of dual attitudes, there is no reason to assume that an implicit attitude is any more affective- or cognitive-based than an explicit attitude (Wilson et al., 2000). As argued by Wilson and Schooler, both types of attitudes are summary evaluations that can be based on a variety of sources of information (e.g., affective experiences or cognitive process) (Wilson et al., 2000).

### 4.4. Conclusion

This study showed for the first time that overweight French children have implicit hedonic-based attitudes towards food similar to those of normal-weight French children, but they have more explicit nutrition-based attitudes. Moreover, combining implicit and explicit attitudes, we highlighted that a discrepancy between hedonic-based implicit and nutrition-based explicit attitudes is more common in overweight children than in normal-weight children, but this discrepancy is not systematic. This study adds to our knowledge about children's attitudes towards food across different weight status, but there is a need to further investigate the relationship between implicit and explicit measures of attitudes towards food and actual eating behavior notably in different social contexts (e.g., family, school, restaurant) and different cultural contexts (e.g., different countries).

## Authors' contributions

LM collected the data, completed the statistical analysis and drafted the manuscript. SC and SMP developed the implicit and explicit tasks. MB assisted with recruitment at Dijon public hospital. All the authors contributed to the interpretation of the findings and critical revision of the manuscript. All the authors read and approved the final manuscript.

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# Article 3

## Implicit and explicit attitudes toward food in American and French children: A cross-cultural study

**Marty L.,** Monnery-Patris S., Chambaron S., Nicklaus S., Forestell C. A.

*Soumis à Appetite*

## OBJECTIFS & PRINCIPAUX RESULTATS

L'objectif de l'**Article 3** était de comparer la dominance relative des bases hédoniques et nutritionnelles des attitudes implicites et explicites envers l'alimentation entre les enfants français et américains.

Nous avons montré que les attitudes implicites des enfants américains étaient significativement plus basées sur le plaisir que les attitudes implicites des enfants français. En revanche, nous n'avons pas observé de différence quant à la dominance relative des bases hédoniques et nutritionnelles des attitudes explicites entre les enfants français et américains.

**Implicit and explicit attitudes toward food in American and French children: A cross-cultural study**

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**Abstract**

This study explored the relative dominance of nutrition- and hedonic-based attitudes toward food in American and French children using implicit and explicit tasks. American ($n$=77; age=8.5±1.74 years) and French children ($n$=63; age=8.2±1.22 years) performed two country-adapted tasks that assessed their attitudes toward food. Implicit attitudes were assessed with a pairing task in which children were presented with 10 picture triplets and asked to choose two food items that "best go together". For each triplet, foods could be paired according to their hedonic or nutritional characteristics. Explicit attitudes were assessed with a task in which children placed each of 48 food items into one of the following categories: "yummy", "yucky" (i.e., hedonic categories), "makes you strong", or "makes you fat" (i.e., nutritional categories). The results showed that implicit hedonic pairings were more frequent in the American than in the French children ($P$=0.0007), suggesting that the American children had more hedonic spontaneous responses towards food than the French children. However, there was no significant difference in the explicit hedonic categorization between the American and French children ($P$=0.36). The environmental determinants of these culturally-shaped food attitudinal patterns and whether they predict later eating behavior remain to be investigated.

**Keywords:** attitudes, cross-cultural comparison, food, children

## 1. Introduction

American and French people differ in their attitudes toward food. While Americans associate food with nutrition and health, the French associate food with pleasure (Rozin, Fishler, Imada, Sarubin, & Wrzesniewski, 1999). As a result, the French who focus more on the pleasurable experience of eating may experience less stress than Americans who focus more on the health consequences of eating (Fischler & Masson, 2008). According to Rozin and his colleagues (1999), these cultural differences in attitudes may partially explain the French Paradox – a phenomenon in which cardiovascular disease and obesity occur at lower rates in France than in the United States despite the rich foods that characterize French cuisine (Drewnowski et al. 1996).

In all cultures, food-related attitudes are formed early in life, and shape dietary habits that track into adulthood (for reviews see: Forestell, 2017; Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011). Although a better understanding of this developmental process is needed, little research has investigated the development of nutrition and hedonic-related attitudes, and virtually no studies have compared food-related attitudes of children across cultures. The aim of the present study was to compare the degree to which American and French children's attitudes reflected the hedonic vs. nutritional components.

### *1.1. Attitude definition and measurement*

Attitudes are commonly viewed as memory associations between objects and their evaluations that guide behavior toward these objects (Fazio, 1990, 1995). Attitudes combine cognitive and affective components that vary in their relative dominance to form global evaluations of objects (Crites, Fabrigar, & Petty, 1994; Leclerc, Schmitt, & Dubé, 1994; Millar & Tesser, 1986, 1989).

It has long been recognized that explicit or conscious, self-report measures of attitudes have problems of validity (Rosenberg, 1969; Webb, Campbell, Schwartz, & Sechrest, 1966) because they rely on the participants' ability and willingness to accurately assess and report their feelings. Because participants can exert control over their conscious responses in a way that obscures underlying evaluations, responses that are based on implicit or automatically activated evaluations and associations are thought to provide a more accurate measure of one's attitudes. Implicit measures of attitudes, which are typically inferred from performance on response latency measures, such as the Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998), have proven to be useful in assessing attitudes toward a variety of social constructs (Baron & Banaji, 2006).

### *1.2. Attitudes toward food in adults and children*

In the food domain, attitudes consist of cognitive and affective dimensions. Whereas the cognitive component encompasses the positive and negative attributes and beliefs about a food item (e.g., its nutritional value and health consequences), the affective component pertains to the sensations, feelings and emotions experienced in response to a food item (i.e., hedonic tone) (Cantin & Dubé, 1999). As discussed above, the degree to which the cognitive and affective dimensions influence adult attitudes appears to vary between cultures, with the affective or hedonic dimension dominating in French culture and the cognitive or nutritional dimension dominating in American culture (Rozin, Fishler, Imada, Sarubin, & Wrzesniewski, 1999). However, the work that compared the dominant basis of attitudes toward food between American and French culture (i.e., affective versus cognitive) was only conducted in adults and employed only explicit measures. To our knowledge, no research has investigated the degree to which French and American people differ in the affective versus cognitive dominance of implicit and explicit attitudes toward food, especially in children.

In a recent French study, a new methodology was developed to assess implicit and explicit food-related attitudes in French children (Monnery-Patris, Marty, Bayer, Nicklaus, & Chambaron, 2016). Using an implicit pairing task in which children could select pairs of foods based on their hedonic or nutritional qualities, they reported that on the majority of trials (81% on average) the food pairs selected reflected the hedonic quality of the food, and this percentage of hedonic pairs significantly increased with age. In contrast, in the explicit task, which required children to categorize foods into nutritional or hedonic categories, nutrition-driven categorizations increased with age. These tasks were then used to compare attitudes towards food between normal- and overweight French children (Marty, Chambaron, Bournez, Nicklaus, & Monnery-Patris, 2017). The results showed no difference in children's responses in the implicit task based on their weight status, but children who were overweight were more likely to make nutrition-based categorizations than children who were normal-weight.

The authors hypothesized that the implicit pairing task reflected passive assimilation of cultural food values among children who were growing up in the French cultural context where hedonic responses and pleasure-oriented attitudes were dominant. In contrast, the explicit categorization task reflected an intentional education about the nutritional characteristics of food that were likely communicated by a combination of sources, such as family expectations, media information about nutrition, and health promotion programs.

### *1.3. The present study*

Here our objective was to investigate whether children's attitudes toward food differed as a function of cultural context. American and French children's attitudes toward food were assessed using a country-adapted implicit pairing task and an explicit categorization task developed by Monnery-Patris and colleagues (2016). Based on previous findings that have employed implicit and explicit tasks with children (Marty et al., 2017; Monnery-Patris et al.,

2016), we hypothesized that French and American children would differ in both their implicit and explicit responses to food. Specifically, we predicted implicit attitudes, which are thought to reflect passive assimilation of cultural attitudes as well as explicit attitudes, which are thought to reflect family expectations, media information about nutrition, or health promotion programs, would differ in the American and the French contexts. Based on Rozin et al.'s findings (Rozin, Fischler, Imada, Sarubin, & Wrzesniewski, 1999) we expected that American children would have nutrition-based attitudes, whereas French children would have hedonic-based attitudes toward foods.

## 2. Method

### *2.1. Participants*

One hundred forty-six children (82 American and 64 French) between 6 and 11 years old were recruited for the present study. The American children were recruited between February and March 2017 via ads published in local digests or local websites from Williamsburg, Virginia. The French children were recruited between March and May 2017 from two elementary schools in Dijon, France, and from a population registered in the Chemosens Platform's PanelSens database. This database complies with national data protection rules and has been vetted by the appropriate authority (Commission Nationale Informatique et Libertés – CNIL – no. 1148039). Moreover, 8 overweight French children were specifically recruited from pediatric weight care consultations at the Dijon public hospital to ensure that the weight status in the American and French children samples was similar on average. A power calculation based on a previous study (Monnery-Patris et al., 2016) indicated that a minimal sample size of 120 participants (60 French and 60 American children) would be needed to detect a significant difference in attitudinal scores (difference ± SD: 11±22%) across the two countries, with an 80% power at $\alpha$=0.05.

116 The study was conducted in accordance with the Declaration of Helsinki and was
117 approved by the local Internal Review Board in both countries (Comité pour la Protection des
118 Personnes EST-1 Burgundy, file number: 2015-A00017-42, in France; the College of William
119 and Mary protection of human subjects committee, file number: PHSC-2016-09-30-11466, in
120 the United States). Written informed consent was obtained from parents before their child's
121 participation in the study.

122 *2.2. Materials and Procedure*

123 The children participated individually or in small groups in a session that involved two
124 tasks: an implicit pairing task followed by a forced-choice explicit categorization task. Each
125 child was provided with touch-screen tablet and headphones for the administration of the task.
126 The tasks were self-administered in a quiet room at school or in an experimental lab in
127 France, and in an experimental lab in the United Sates. An experienced interviewer was
128 present to give the initial instructions and was available for consultation if needed. After
129 performing the two tasks, the American children were asked about their motivations
130 underlying each association they performed.

131 *2.2.1. The implicit pairing task*

132 The implicit pairing task was initially developed and validated in French by Monnery-
133 Patris et al. (2016). In this task, 11 triplets of food item pictures were successively presented,
134 including an initial training triplet (strawberry, raspberry and whipped cream) followed by 10
135 test triplets (chicken, steak and French fries; baguette, butter and Nutella; tomatoes, olive oil
136 and mayonnaise; cigarette cookies, chocolate chip cookies and applesauce; white bread,
137 baguette and jam; waffle, pancakes and jam; plain cookies, chocolate chip cookies and
138 applesauce; chicken, French fries and potato wedges; fruit salad, cigarette cookies and
139 applesauce; and pasta, rice and steak) presented in a random order. For each triplet of foods,

children were asked to “choose the two foods that best go together”. The children were able to perform hedonic associations by pairing two food items that are typically consumed together (e.g., steak with fries or chicken with fries) or a nutritional association by pairing the two nutritionally similar food items (e.g., steak with chicken because they both belong to the meat category). The instructions and names of each food item were read aloud by the tablet computer when the food pictures appeared on the screen. For each triplet, the children answered by touching the two pictures on the screen that they thought best went together. This action was recorded by the program, and no feedback was given. The pairing task required approximately 5 min.

The American version of the implicit pairing task was identical to the French version except that the instructions were translated from French to English using a back-translation procedure and recorded on the tablets by a native English speaker. Additionally, the foods represented on the pictures were adapted to the American food context. A pretest via an online questionnaire was conducted with 78 American parents of 6- to 11-year-old children. Parents were presented with 86 labelled food pictures. For each food item, they were asked if their child had ever tried these foods. Only foods that were familiar for 6- to 11-year-old American children were included in the American version of the task (i.e., foods tried by at least 75% of the children). Whenever possible, the food items from the French version of the task were included in the American version.

Finally, for the American version of the implicit pairing task, 11 triplets of food-item pictures were selected: four were identical to the French version and seven were culturally-adapted. It included an initial training triplet (strawberry, raspberry and whipped cream) followed by 10 randomized test triplets (chicken, steak and French fries; white bread, butter and peanut butter; tomatoes, ranch dressing and mayonnaise; syrup, jam and pancakes; white bread, baguette bread and jam; waffle, pancakes and jam; ranch dressing, mayonnaise and

carrots; chicken, French fries and potato wedges; ranch dressing, cucumbers and carrots; potato wedges, rice and steak).

Additionally, the qualitative analysis of American children's pairing motivations led to the conclusion that nutritional and hedonic pairings were justified by the appropriate justifications for 9 of the 10 test triplets. For the triplet including a waffle, pancakes and jam, the analysis revealed that most of the American children did not spread jam on either their waffles or pancakes, and 68% of the waffle-pancakes pairings were motivated by hedonic reasons such as "they go together but not necessarily with jam" or "I like them together". For this reason, this triplet was removed from the hedonic pairing score calculation for American children.

### *2.2.2. The explicit forced-choice categorization task*

The forced-choice categorization task was initially developed and validated in French by Monnery-Patris et al. (2016). In this task, children were presented with a total of 51 food pictures on a touch-screen tablet, including 3 for initial training (banana, lollipop, and rice) followed by 48 randomized test food item pictures: 9 fruits (red apple, grapefruit, orange, melon, grapes, pear, kiwi, nectarine, and fruit salad), 10 vegetables (tomatoes, carrots, cucumber, string beans, peas, vegetable soup, zucchini, mixed vegetables, ratatouille and lentils) that were aggregated in the "fruit and vegetables" group; 6 animal proteins (fish fillet, salmon steak, beef steak, lamb chop, fried egg, and omelet) aggregated in the "meat, fish and eggs" group; 4 cheeses (Gruyere, Camembert, Roquefort, and goat cheese) aggregated in the "cheese" group; and 4 high-fat dishes (hamburger, lasagna, pizza, and French fries), 3 salted snacks (chips, pretzels, and small quiche), 12 sweet snacks (croissant, plain cookies, candies, chocolate, and candy bar, chocolate éclair, strawberry ice-lolly, caramel cream, ice cream, apple pie, chocolate cake, and chocolate pudding) aggregated in the "foods high in fat, salt and sugar" group. The children chose whether each food item was "yummy" ("*c'est miam*" in

190 French) or "yucky" ("*c'est beurk*"), grouped in the hedonic dimension, or whether it "makes
191 you strong" ("*ça donne des forces*") or "makes you fat" ("*ça fait grossir*"), grouped in the
192 nutritional dimension, by touching the corresponding pictogram on the tablet. Another
193 category, "I don't know this food", was also available. The meaning of each pictogram was
194 provided for the 3 first food items. The tablet computer read aloud the instructions and the
195 name of each food item. Their choice was recorded by the program, and no feedback was
196 provided. This task lasted approximately 10–15 min.

197 Using the same procedure as for the implicit pairing task, the instructions and the
198 foods presented in the forced-choice categorization task were adapted to the American
199 context. A total of 51 food pictures were selected for the American version of the explicit
200 forced-choice categorization task: 34 were identical to the French version and 17 were
201 culturally-adapted. It included 3 food items for initial training (banana, lollipop, and rice)
202 followed by 48 randomized test food-item pictures: 10 fruits (apple, honeydew melon, orange,
203 cantaloupe, grapes, pear, applesauce, peach, strawberries and fruit salad) and 9 vegetables
204 (tomatoes, carrots, cucumber, string beans, peas, vegetable soup, mixed vegetables, corn and
205 beans) that were aggregated in the "fruit and vegetables" group; 5 animal protein dishes
206 (chicken, bacon, steak, fried egg, and omelet) aggregated in the "meat, fish and eggs" group;
207 4 cheeses (Swiss cheese, cheddar cheese, processed cheese, and cream cheese) aggregated in
208 the "cheese" group; and 4 high-fat dishes (hamburger, lasagna, pizza, and hotdog), 4 salted
209 snacks (crisps, pretzels, potato wedges and French fries), 12 sweet snacks (croissant, cookies,
210 candies, chocolate, candy bar, donut, cinnamon roll, jello, ice cream, apple pie, brownie, and
211 chocolate pudding) aggregated in the "foods high in fat, salt and sugar" group.

212 *2.2.3. Children's anthropometrics*

213 Trained researchers measured children's weight and height. Weight (kg) was measured
214 with the child wearing light clothes and no shoes to the nearest 0.1 kg using a digital scale

(Soehnle, Benfeld, Germany, in France, and Seca, Hambug, Germany, in the USA); height (cm) was measured to the nearest 0.1 cm with the child in a standing position without shoes using a stadiometer (Seca Leicester, Birmingham, UK, in France, and Seca, Hamburg, Germany, in the USA). Body mass index (BMI) was calculated and transformed into age- and sex-standardized z-scores (z-BMI) based on the World Health Organization growth reference for school-aged children (De Onis et al., 2007). Children were considered overweight when z-BMI > 2.

*2.3. Data management and statistical method*

A hedonic pairing score based on the percentage of hedonic associations performed during the implicit pairing task was calculated for each child (range: 0–100%). This score was hypothesized to reflect the relative dominance of implicit hedonic-based attitudes toward food over implicit nutrition-based attitudes toward food. A hedonic categorization score based on the percentage of hedonic answers (i.e., "yummy" or "yucky") for known foods performed during the explicit forced-choice categorization task was calculated for each child (range: 0–100%). This score was hypothesized to reflect the relative dominance of explicit hedonic-based attitudes toward food over explicit nutrition-based attitudes toward food. Regarding the French data, no significant effect of the recruitment places on the hedonic scores was found, thus data were pooled. Analyses of covariance (ANCOVAs) were performed to test the effect of country, adjusted for age and z-BMI, on the hedonic pairing score and the hedonic categorization score because previous studies (Marty et al., 2017; Monnery-Patris et al., 2016) have shown a significant effect of these two variables on the hedonic scores. Additionally, a hedonic categorization score was calculated for each food group (i.e., "fruit and vegetables", "meat, fish and eggs", "cheese" and "foods high in fat, salt and sugar"). ANCOVAs were performed to test the effect of country, adjusted for age and z-BMI, on the hedonic categorization scores calculated by food groups.

240 The statistical analyses were performed using SAS software version 9.3 (SAS
241 Institute, Inc., 2012 SAS® 9.3. Cary, NC: SAS Institute Inc.). Significance was set at *P*=0.05.
242 The results are expressed as the mean±SD.

243 ## 3. Results

244 ### *3.1.Sample*

245 Of the 146 participants, four children (three American and one French) did not
246 complete the two tasks and two additional American children were vegan. These data were
247 removed from the analyses. Consequently, analyses were run on a sample of 140 children; 77
248 American children and 63 French children with similar characteristics in terms of age, sex and
249 weight status (**Table 1**).

250 **Table 1.** Participants' characteristics.

| | All (*n*=140) | American (*n*=77) | French (*n*=63) |
|---|---|---|---|
| Age | 8.4±1.5 | 8.5±1.7 | 8.2±1.2 |
| Sex (f/m) | 81/59 | 40/37 | 41/22 |
| z-BMI | 0.29±1.29 | 0.16±1.33 | 0.63±1.17 |
| Weight status (ow/nw) | 17/123 | 9/68 | 8/55 |

251 Abbreviations: f, female; m, male; ow, overweight children; nw, normal-weight children

252 ### *3.2. The implicit pairing task*

253 On average, the hedonic pairing score was 87±17% for American and 72±34% for
254 French children (**Figure 1**). The statistical analysis showed a significant main effect for
255 country [$F(1,136)$=7.49, $P$ = 0.0007] adjusted for age [$F(1,136)$=9.00, $P$ = 0.003] and z-BMI
256 [$F(1,136)$=1.45, $P$ = 0.23] on hedonic pairing scores.

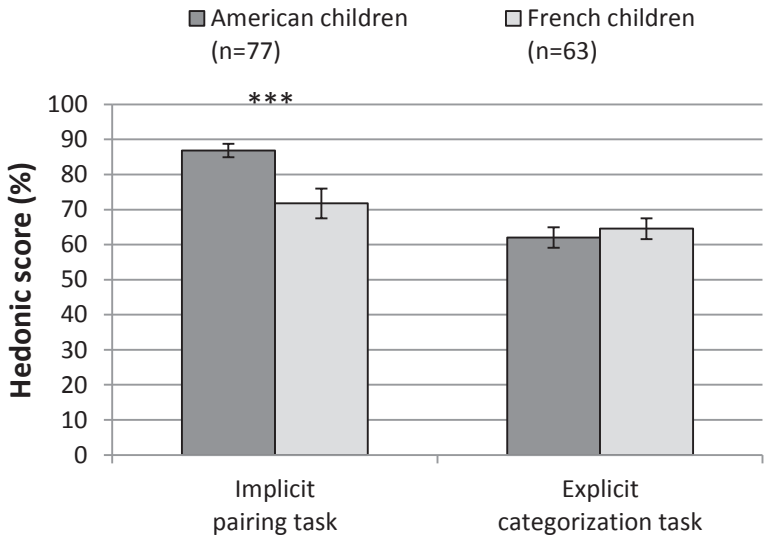


**Figure 1.** Implicit and explicit hedonic scores in American and French children. Values are means±SEM. Group differences were assessed by using ANCOVA after control for age and z-BMI: ***$P$<0.001

*3.3.The explicit forced-choice categorization task*

On average, the hedonic categorization score was 62±26% for American and 65±23% for French children (**Figure 1**). The statistical analysis showed no significant main effect for country [$F(1,136)$=0.85, $P$=0.36] adjusted for age [$F(1,136)$=9.19, $P$=0.003] and z-BMI [$F(1,136)$=6.62.0, $P$=0.01] on hedonic categorization scores.

Additional analyses by food groups showed no significant main effect for country adjusted for age and z-BMI on explicit hedonic scores for "fruit and vegetables" [$F(1,136)$=0.85, $P$=0.36], "foods high in fat, salt and sugar" [$F(1,136)$=0.99, $P$=0.32] and "meat, fish and eggs" [$F(1,136)$=1.42, $P$=0.24], and only a marginal effect for "cheese" [$F(1,136)$=3.68, $P$=0.06] (**Figure 2**).

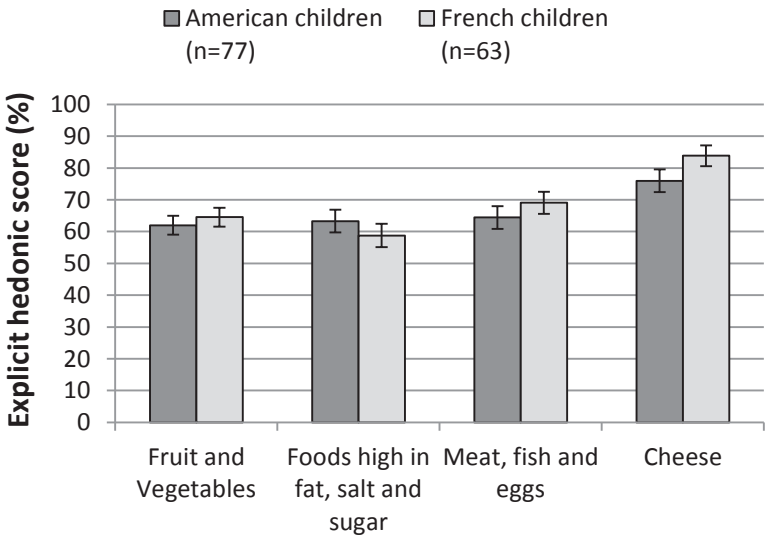


**Figure 2.** Explicit hedonic scores in American and French children by food groups. Values are means±SEM. Group differences were assessed by using ANCOVA after control for age and z-BMI: $^{\#}P<0.1$

## 4. Discussion

The main goal of this study was to investigate cultural differences in attitudes toward food in American and French children. In particular, we were interested in the relative dominance of hedonic- versus nutrition-based implicit and explicit attitudes of American and French children. We found a higher proportion of responses were hedonically-based in American children compared to French children. In contrast, explicit hedonic responses were similar between French and American children.

That the implicit hedonic scores were high in American and French children suggests that the representation automatically activated by food in both cultures was primarily associated with pleasure. Indeed, the implicit hedonic score is likely to reflect the passive impregnation and appropriation of cultural food values among children. Our results showed that the proportion of implicit hedonic associations was higher in American than French children; it is possible that this reflects the degree to which the American culture encourages

food consumption based on pleasure relative to that of the French culture. In contrast to the implicit task, American and French children did not differ in the proportion of trials in which they explicitly categorized the food hedonically, suggesting that American and French children do not differ in their level of explicit focus on the nutritional characteristics of foods. This may be a result of similar exposure to information about nutrition or health promotion programs in the United States and France.

The finding that a higher proportion of American children implicitly paired the food items based on hedonic criteria and that the same proportion of American and French children explicitly categorized foods based on hedonic criteria versus nutrition criteria is surprising if we compare these responses to adults (i.e., Rozin et al., 1999). Rozin and colleagues have suggested that relative to France, the American context generates more food-related stress and a higher level of concern regarding the health consequences of foods in adults (Rozin et al., 1999; Rozin, 2005). Although it is possible that attitudes toward foods follow a developmental trajectory, where American children experience less stress because they are less concerned about the health consequences of unhealthy foods, it is also possible that over the last 10-20 years the French context has changed to become more similar to that of the United States, or even more focused on healthy eating.

If the implicit pairing task does in fact measure cultural food habits among children, we might suggest that hedonic associations (i.e., pairing two foods that are typically consumed together) were strengthened by the American food context. On average, American children chose a higher proportion of food pairs that are typically consumed together relative to French children. This suggests that hedonic associations were more accessible in memory for American children than for French children. This heightened accessibility may have occurred for a number of reasons, one of which may be due to less food diversity in the US compared to France. While French adults generally consume close to 17 different food

313 products over the course of two days Americans consume fewer than 14 foods over the same
314 period (Mathe, Francou, Colin, & Hebel, 2011). If like their parents, American children also
315 consume a smaller variety of foods, each culinary association chosen in the implicit pairing
316 task would have had a better chance to be remembered by the American children resulting in
317 a higher proportion of hedonic pairings.
318 The explicit hedonic score is more likely to reflect intentional education about food
319 through media information or health promotion programs that are disseminated in both
320 countries. In the US and in France, childhood obesity (including overweight) is a public
321 health problem concerning 54% of American children between 1999 and 2012 (Skinner
322 Cockrell & Skelton, 2014), and 17% of French children in 2015 (Verdot, Torres, Salanave, &
323 Deschamps, 2017). In response to this concern, programs have been developed in both
324 countries to educate children about the importance of healthful eating habits. In France,
325 national health promotion campaigns have displayed nutritional information such as “For your
326 health, eat at least five fruits and vegetables per day” or “For your health, avoid salty, sweet
327 and fatty foods” since 2001 (Hercberg, Chat-Yung, & Chauliac, 2008). Moreover, nutrition
328 education has been part of the teaching content at primary schools in France since 2003
329 (Neulat, 2005). In the United States, by 2006 elementary schools were devoting a median of
330 3-4 hours of nutrition education in the curriculum (Kann, Telljohann, & Wooley, 2007), and
331 by 2012 82% of districts had adopted a policy stating that elementary schools would teach
332 specific health topics (Kann, Telljohann, Hunt, Hunt, & Haller, 2013). These trends in
333 nutritional education within the school system continue today. These similarities in nutrition
334 education between America and France might explain children’s explicit responses in the
335 current study. It would be interesting to properly define comparable indicators to characterize
336 the two contexts with regard to the dominance of health promotion messages and nutrition

337 education addressed to children in order to further understand the determinants of attitudes
338 toward food.

339 A potential limitation of the comparison of American and French children's attitudes
340 is that the food items used differed between countries. We took care to replace typical French
341 foods, unfamiliar for American children, by popular American foods from the same food
342 groups. We adapted the American food pictures to conform to American culture to ensure that
343 the children's responses would not be biased. However, the French and American food
344 cultures are likely to differ on various dimensions. French portion sizes seem to be about 25%
345 smaller than American portions, judging by restaurant portions, individual portion-size foods
346 in supermarkets and portions designated in cookbooks (Rozin et al., 2003). Moreover, the
347 French eat more slowly (i.e., the mean eating time was 22.3 minutes in France versus 13.2
348 minutes in the United States) and are more social during their meals (Rozin et al., 2003) and
349 as a result, spend twice as much time eating (11.11% of time) than the Americans (5.22% of
350 time) (Krueger et al., 2009). Overall, Rozin (2005) suggested that the French focus more on
351 quality rather than quantity contrary to Americans. This may have implications in terms of
352 social norms that are associated with eating. Our implicit and explicit tasks may have been
353 unable to capture all the differences that exist between French and American cultures.
354 However, to our knowledge, this is the first attempt to investigate the potential differences
355 between French and American children's attitudes toward food. To better understand how
356 attitudes toward food are shaped during childhood, there is a need to further investigate
357 cultural differences, for instance the social norms related to eating in both countries.

358 **5. Conclusion**

359 The aim of the present study was to compare attitudes toward food between American
360 and French children, especially the relative dominance of hedonic- versus nutrition-based
361 attitudes. Contrary to what could have been expected based on previous research in adults

(Rozin et al., 1999), the American and French children explicitly categorized foods based on hedonic or nutrition criteria in the same proportion. One possible explanation of the discrepancy between these findings may be explained by changes in the French environment, notably since 2001 with the broadcasting of nutrition and health messages in the French media. Moreover, we highlighted that American children have more hedonic-based implicit attitudes toward food than French children, suggesting cultural differences in beliefs and attitudes about eating among children.

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# CHAPITRE 4 : PROFIL ATTITUDINAL SANTE/PLAISIR ET CHOIX ALIMENTAIRE CHEZ L'ENFANT

# Article 4

**Do hedonic- versus nutrition-based attitudes toward food predict food choices? A cross-sectional study of 6- to 11- year-olds**

**Marty L.**, Miguet M., Bournez M., Nicklaus S., Chambaron S., Monnery-Patris S.

*En révision pour International Journal of Behavioral Nutrition and Physical Activity*

## OBJECTIFS & PRINCIPAUX RESULTATS

L'objectif de l'**Article 4** était d'étudier l'influence de la dominance relative des bases hédoniques et nutritionnelles des attitudes implicites et explicites envers l'alimentation sur les choix alimentaires des enfants.

Les résultats ont montré que les enfants présentant les attitudes implicites et explicites les plus basées sur la nutrition effectuaient les choix alimentaires les moins favorables à la santé.

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International Journal of Behavioral Nutrition and Physical Activity

RESEARCH Open Access

# Do hedonic- versus nutrition-based attitudes toward food predict food choices? a cross-sectional study of 6- to 11-year-olds

Lucile Marty[1,3], Maud Miguet[1], Marie Bournez[1,2], Sophie Nicklaus[1], Stéphanie Chambaron[1] and Sandrine Monnery-Patris[1*]

## Abstract

**Background:** Implicit and explicit attitudes are potential precursors of food choices and combine affective and cognitive components that can vary in their relative dominance. Yet, the affective and cognitive components of attitudes toward food can lead to distinct predisposition toward a food item and potentially to different food choices. In the food domain, the affective component pertains to the hedonic tone of consumption, while the cognitive component encompasses nutritional value or health consequences of food. The present study investigated whether hedonic- versus nutrition-based implicit and/or explicit attitudes toward food predicts children's healthy versus unhealthy food choices.

**Methods:** A total of 63 children (age range = 6.3–11.5) participated in a 90-min session at 5 pm (i.e., afterschool snack time in France). The children were asked to choose five food items from a buffet featuring five healthy and five unhealthy sweet foods pretested as being highly liked. Children ate what they had chosen. Moreover, their implicit attitudes were assessed with a pairing task in which children were presented with 10 food triplets and asked to choose two food items that "best go together". For each triplet, foods could be paired according to their hedonic or nutritional characteristics. Explicit attitudes were assessed with a task in which children placed each of 48 food items into one of the following categories: "yummy", "yucky" (i.e., hedonic categories), "makes you strong", or "makes you fat" (i.e., nutritional categories).

**Results:** Both implicit and explicit attitudes significantly influenced children's food choices. We observed that children with more hedonic-based implicit or explicit attitudes toward food were more likely to choose healthy food options from the buffet. Conversely, children with both implicit and explicit nutrition-based attitudes chose less healthy foods.

**Conclusions:** Hedonic-based attitudes toward food seem to drive healthier food choices in children compared with nutrition-based attitudes in this particular eating context. These findings suggest that pleasure from eating might be an ally with regard to healthy eating among children. Additional research is needed to understand the etiology of children's attitudes toward food in order to provide insights on how to shape adequate children's attitudes to guide them toward healthy food choices.

**Keywords:** Attitudes, Food choices, Children, Nutrition, Hedonic

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## Background

Pleasure from eating is an innate driver of food consumption, and food likes and dislikes are strong predictors of children's food choices [1, 2]. However, children's food preferences generally do not align with dietary recommendations: they typically rate energy-dense foods as the most liked and vegetables as the least liked foods [3–7]. To encourage children to adopt a healthy diet, parents, caregivers, and national campaigns display nutritional information [8]. In this context, children acquire an early awareness about both the hedonic and nutritional values of food. Five-year-olds are able to classify food products considering both hedonic and nutritional perceptions [9]. Interestingly, qualitative studies have shown that children consider both hedonic and nutritional perceptions as factors that influence their food choices [10, 11]. A better understanding of the factors that underlie healthy or unhealthy eating in children is of particular importance because eating habits remain stable from childhood to adulthood [12, 13]. However, surprisingly sparse research has examined the relative influence of hedonic versus nutritional considerations on children's food choices [14]. To fill this gap, the current study investigated the relationship between children's attitudes toward food (in particular, the relative dominance of nutrition- versus hedonic-based attitudes) and children's choices of healthy versus unhealthy foods.

Attitudes are commonly viewed as memory associations between objects and their evaluations that guide behavior toward these objects [15, 16]. Attitudes combine cognitive and affective components that can vary in their relative dominance to form global evaluations of an object [17–20]. In the food domain, the affective component pertains to the sensations, feelings and emotions experienced in response to a food item (e.g., the hedonic tone of consumption), whereas the cognitive component encompasses the positive and negative attributes and beliefs about a food item (e.g., its nutritional value and health consequences) [21]. Importantly, Dubé and Cantin showed that the relative dominance of affective or cognitive components of attitudes toward a food item influences eating behavior [22]. In fact, the affective and cognitive basis of attitudes toward food can lead to distinct evaluative consequences. The affective component of attitudes toward a food item (e.g., chips) can lead to a positive evaluation because it is tasty, whereas the cognitive component of the attitude can lead to a negative evaluation because it is unhealthy. One's global evaluation of chips may differ depending on whether one favors the affective or cognitive component. Thus, primarily hedonic-based (i.e., affect-based) or nutrition-based (i.e., cognitive-based) attitudes toward food can lead to different food choices.

In addition, numerous psychology studies have demonstrated the influence of non-conscious processes on decision making [23–25], and the distinction between implicit and explicit attitudes has emerged [26]. Implicit attitudes likely operate automatically in a non-conscious fashion, whereas explicit attitudes are likely retrieved deliberatively under conscious control [26]. Several attempts have been made to develop predictive models combining implicit and explicit attitudes and their influences on behavior [27–29]. Three major models have been proposed in the literature and tested in a food context by Perugini [30]: (1) additive (the two types of attitudes explain different proportions of the variance of behavior), (2) double dissociation (implicit attitudes predict spontaneous behaviors, whereas explicit attitudes predict deliberative behaviors), and (3) multiplicative (implicit and explicit attitudes interact to influence behavior). Perugini observed that the double dissociation model of Wilson et al. [27] predicted eating behaviors: implicit attitudes were significantly related to spontaneous eating behaviors (namely, the choice of a snack or fruit at the end of the experiment), whereas a significant relationship was found between explicit attitudes and deliberative behavior (namely, the self-reported consumption of snacks and fruit during an average week) [30]. Interestingly, König et al. recently showed that both explicit and implicit attitudes were independent precursors of food choice in a binary-option choice task. Conversely, in a multiple-option choice task, the effects of explicit and implicit attitudes were qualified by an interaction. The participants served themselves more sweets than fruit when their implicit and explicit attitudes revealed a consistent preference for sweets, as well as when one attitude type (i.e., either the implicit or the explicit one) indicated a preference for sweets while the other indicated a preference for fruit [31]. Contrary to Perugini's conclusion [30], these results support the additive model using a binary-option food-choice task and suggest a shift from the additive to the multiplicative predictive model when multiple food options are offered. In summary, although both implicit and explicit attitudes influence eating behaviors, how they interact to predict eating behavior remains unclear.

Only few studies have investigated both implicit and explicit attitudes toward food in children [32–34] and, to our knowledge, the relationships between implicit and explicit attitudes and food choices has never been investigated in children. In a recent study, a new method was developed to assess hedonic versus nutritional basis of implicit and explicit food-related attitudes in children [34]. This new method included two tasks appropriate for use with children from 5 to 11 years old. The implicit attitudes were assessed with a pairing task, in which children were presented with food pictures triplets and asked to choose two food items that "best go together". For each triplet, foods could be paired according to their hedonic or nutritional characteristics. Explicit attitudes were assessed with a categorization task in which

children placed food items into one of the following categories: "yummy", "yucky" (i.e., hedonic categories), "makes you strong", or "makes you fat" (i.e., nutritional categories). For both tasks, for each trial, children had to choose between a hedonic-based and a nutrition-based answer. It was assumed that the proportion of hedonic- or nutrition-based answers would reflect the relative dominance of the hedonic or nutritional basis of implicit and explicit attitudes. The first study using these two tasks revealed an increase in implicit hedonic-based attitudes but a decrease in explicit hedonic-based attitudes with school level [34]. The tasks were also used to compare attitudes towards food between children with or without overweigh [33]. The results showed no difference in children's responses in the implicit task based on their weight status, but children who were overweight were more likely to make nutrition-based categorizations than children who were normal-weight.

Following on from these results, the present study investigated whether the relative dominance of the nutritional (i.e., cognitive) versus hedonic (i.e., affective) components of implicit and explicit attitudes toward food are associated with children's choices of healthy versus unhealthy foods. During an experimental session, children chose five of 10 highly appreciated healthy or unhealthy sweet food items to compose a snack they had to eat. Moreover, children's attitudes toward food were assessed using the implicit pairing task and the explicit categorization task developed by Monnery-Patris et al. [34]. Based on the literature regarding adults [30, 31], we assumed that both implicit and explicit attitudes would predict the healthiness of children's food choices. On one hand, nutritional interventions commonly assume that knowledge about the nutritional value of food improves the nutritional quality of children's diets [35–37]. Based on this perspective, having nutrition-based attitudes toward food should drive healthier food choices in children. On the other hand, cross-cultural studies of adults have highlighted the positive relationship between hedonic perceptions of food consumption and overall health status [38, 39]. In addition, some evidence suggests that emphasizing hedonic considerations toward food may drive healthy eating behaviors in children [40]. Thus, it could be assumed that hedonic-based attitudes toward food would drive healthier food choices in children.

## Methods

### Participants

A power calculation to detect a large effect ($f^2 = 0.35$), assuming three predictors in a linear multiple regression, led to a sample size of 35 participants for 80% power at $\alpha = 0.05$. The expected effect size was based on the results of König et al. (2016) who investigated the influence of implicit and explicit attitudes on food choices in a multiple-option food choice task [31]. A total of 63 children participated in this study (mean ± SD age = 8.99 ± 1.51, age range = 6.3–11.5 years, mean ± SD BMI (Body Mass Index) z-score = 1.65 ± 1.92, BMI z-score range = −1.74–5.74; 31 girls, 32 boys). Children were recruited from 6 to 11 years old because the implicit pairing task and the explicit categorization task were developed and adapted for this age range. Moreover, based on the results of a previous study using the same method [33], children varying in weight status were recruited to maximize the attitudinal variability of the sample. Children were recruited from a population registered in the Chemosens Platform's PanelSens database. This database was declared to the relevant authority (Commission Nationale Informatique et Libertés; CNIL; n°1,148,039). Children with high body mass index z-scores (z-BMI) were specifically recruited from pediatric weight care consultations at a local hospital. The study was conducted in accordance with the Declaration of Helsinki and approved by the local ethical committee (Comité pour la Protection des Personnes EST-1 Burgundy, file number: 2015-A01547–42). Based on a recruitment questionnaire, children with food allergies were excluded. Written informed consent was obtained from both parents before their child's participation. We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were adhered to throughout this study.

### Overview

The children and their parents were invited to a 90-min session after school (i.e., from 5 to 6:30 pm during weekdays) that occurred in our laboratory. The experiment was conducted with a maximum of 8 children per session and a minimum of 3. Children in the same session did not know each other. Parents were asked not to give their children a snack during the afternoon before the experiment. We welcomed the children and their parents in a waiting room, and only the children were invited to enter the experimental room. First, the children were asked to choose five snacks from an individual buffet and had time to eat what they had chosen. They made their choices individually but consumed their five snacks together at the same table. This protocol (i.e., first, individual choices, then commensal consumption) has been selected since it is very close to the meal proceedings at schools in France, in particular for afternoon snack. Hidden video cameras recorded the food choices of the children without their knowledge. Each individual buffet was separated from the others by two partitions to avoid interactions between children and to limit peer influence. Then, we measured the children's attitudes toward food by placing them at separated tables. They performed an implicit and an explicit task on a computer.

The tasks were self-administered, but experimenters were present to provide the initial instructions and were available for consultation if needed. Next, children individually rated their liking and healthiness perception of the foods offered in the buffet. Finally, the children's height and weight were measured. Before leaving, the children received a certificate of participation, and their parents received a €20 voucher.

### Evaluation of food choices

Ten sweet foods, including 5 healthy foods (red apple, banana, kiwi, applesauce and strawberries) and 5 unhealthy foods (donut, chocolate cake, Smarties®, Kinder Bueno® and Gold Bears®) were served to the children in individual buffets (Table 1). These foods were selected based on a pre-testing of children's familiarity with these foods conducted with a separate group of 61 children recruited from children's holiday centers. During face-to-face interviews, the children were presented with pictures of the foods from the Food4Health pictures base [41] and reported whether they had ever tried them.

An individual buffet with 20 small plates (two plates of each food) was prepared for each child in the study (Fig. 1). The foods were not presented in packets. The position of the healthy and unhealthy foods was counterbalanced: two healthy foods at the front and three at the back of the table, alternatively placed, versus three unhealthy foods at the front and two at the back of the table, alternatively placed. Under this predetermined position, healthy and unhealthy foods were randomly presented. Hidden video cameras were placed above each buffet to record the food choices of the children without their knowledge.

**Table 1** Familiarity, energy density (ED) and portion size of the healthy and unhealthy foods served in the buffet

| | Children who had tried the food (%) (pretest: $n = 61$) | ED (kcal/100 g) | Portion weight (g) | Portion energy (kcal) |
|---|---|---|---|---|
| Red apple | 100 | 53.2 | 30 ± 1 | 16 ± 0.5 |
| Banana | 100 | 93.6 | 30 ± 1 | 28 ± 0.9 |
| Kiwi | 93 | 57.7 | 30 ± 1 | 17 ± 0.6 |
| Applesauce | 100 | 54.0 | 40 ± 1 | 22 ± 0.5 |
| Strawberries | 100 | 28.5 | 30 ± 1 | 9 ± 0.3 |
| Donuts | 90 | 400 | 22 ± 1 | 88 ± 4.0 |
| Chocolate cake | 100 | 430 | 15 ± 1 | 65 ± 4.3 |
| Smarties® | 93 | 464 | 15 ± 1 | 70 ± 4.6 |
| Kinder Bueno® | 100 | 572 | 11 ± 1 | 63 ± 5.7 |
| Gold Bears® | 100 | 345 | 21 ± 1 | 72 ± 3.5 |

Values are shown as the means ± SD. Energy density was obtained from the French food composition database [42] or from the food packaging when available

**Fig. 1** Picture of an individual buffet

The video camera began recording before the children entered the experimental room. When the children entered, they were given a tray and assigned to their individual buffet. The children chose five plates to compose their snack. The children were told: "Today, we start the session by a snack! Each of you has an individual buffet prepared. You can choose five food items from your buffet and keep them on your tray. When you have made your choices, you can sit at the table with the other children to eat." The children were able to choose two plates of the same food. They chose foods alone among the foods displayed in their individual buffet. Then, they ate together around the same table on which a glass of tap water (200 mL) and a napkin were available for each of them. They were told that they could leave some food on the plates if they did not want to eat anymore. When they finished, they left their tray on a trolley. After the participants left, the videos were watched. The number of healthy foods chosen by each participant was counted, and the time spent choosing the five food items was recorded.

### Characterization of children's attitudes toward food

#### *Implicit pairing task*

Eleven triplets of food item pictures were successively presented, including an initial training triplet (strawberries, raspberries and whipped cream) followed by 10 test triplets (chicken, steak and French fries; baguette, butter and Nutella; tomatoes, olive oil and mayonnaise; cigarette cookies, chocolate chip cookies and applesauce; white bread, baguette and jam; waffle, pancakes and jam; plain cookies, chocolate chip cookies and applesauce; chicken, French fries and potato wedges; fruit salad, cigarette cookies and applesauce; and pasta, rice and steak) presented in a random order [34]. For each triplet of foods, children were asked to "choose the two foods that best go together". The children were able to perform hedonic associations by

pairing two food items that are typically consumed together (e.g., steak with fries or chicken with fries) or a nutritional association by pairing the two nutritionally similar food items (e.g., steak with chicken because they both belong to the meat category). The instructions and names of each food item were read aloud by the tablet computer when the food pictures appeared on the screen. For each triplet, the children answered by touching the two pictures on the screen that they thought matched. This action was recorded by the program, and no feedback was given. The pairing task required approximately 5 min. An implicit hedonic score based on the percentage of hedonic associations was calculated for each child (range: 0–100%).

#### *Explicit forced-choice categorization task*

A total of 51 food pictures were successively presented on a touch-screen tablet, including 3 for initial training (banana, lollipop, and rice) followed by 48 randomized test food item pictures: 9 fruits (red apple, grapefruit, orange, melon, grapes, pear, kiwi, nectarine, and fruit salad), 10 vegetables (tomatoes, carrots, cucumber, string beans, peas, vegetable soup, zucchini, mixed vegetables, ratatouille and lentils), 6 animal proteins (fish fillet, salmon steak, beef steak, lamb chop, fried egg, and omelet), 4 cheeses (Gruyere, Camembert, Roquefort, and goat cheese), 4 high-fat dishes (hamburger, lasagna, pizza, and French fries), 3 salted snacks (chips, pretzels, and small quiche), 5 sweet snacks (croissant, plain cookies, candies, chocolate, and candy bar), and 7 desserts (chocolate éclair, strawberry ice-lolly, crème caramel, ice cream, apple pie, chocolate cake, and chocolate pudding). The children chose whether each food item was "yummy" or "yucky" (poles of the hedonic dimension) or whether it "makes you strong" or "makes you fat" (poles of the nutritional dimension) by touching the corresponding pictogram on the tablet. Another category, "I don't know this food", was also available. The meaning of each pictogram was provided for the 3 first food items. The tablet computer read aloud the instructions and the name of each food item. Their choice was recorded by the program, and no feedback was provided. This task lasted approximately 10–15 min. An explicit hedonic score based on the percentage of hedonic answers (i.e., "yummy" or "yucky") for known foods was calculated for each child (range: 0–100%).

#### *Validation of the implicit pairing task and the explicit forced-choice categorization task*

To confirm the validity of these measures, a pre-test with 27 different children (mean age = 8.45 years) was initially performed to examine whether hedonic (resp. nutritional) pairings and categorizations actually reflect hedonic (resp. nutritional) considerations [34]. Regarding the implicit pairing task, children were interviewed and their verbatims were collected to ensure that an association such as steak and chicken (coded as a nutritional association) was motivated by nutritional considerations (e.g., "they are both meat"), and that an association such as chicken and French fries (coded as a hedonic association) was motivated by hedonic considerations (e.g., "I like eating chicken with French fries"). The results of the qualitative analysis of children's words led the authors to conclude that hedonic or nutritional pairings were congruently justified by hedonic or nutritional justifications, respectively, for all food triplets. Regarding the explicit categorization task, children were presented with different pictograms assumed to reflect the different categories ("yummy", "yucky", "makes you strong", "makes you fat", and "I don't know this food"). Children were asked to describe each pictogram. Finally, the pictures that were correctly labeled for the purpose of the study by at least 95% of the children were selected. These categories labels were selected by the authors because they referred to concrete situations easily conceptualized by young children. They highlighted that the children preferentially chose concrete answers such as "makes you fat" or "makes you strong" instead of more abstract categories such as "good for your health" or "bad for your health".

### Liking and healthiness perception

During face-to-face interviews, children rated their liking and health perception of the 10 buffet foods based on pictures of these foods. Children were presented with the 10 food pictures, one at a time, and rated their liking (i.e., "How much do you like this food?") using a continuous scale ranging from "I do not like it at all" to "I like it very much", which was coded from 0 to 10, respectively. After they rated their liking for all the foods, they were presented with the 10 food pictures again and rated their healthiness perceptions (i.e., "Is this food healthy?") using a continuous scale ranging from "It is not healthy at all" to "It is very healthy", coded from 0 to 10, respectively.

### Children's anthropometrics

Weight (kg) was measured to the nearest 0.1 kg using a digital scale (Soehnle, Benfeld, Germany) while the children wore light clothes and no shoes; height (cm) was measured to the nearest 0.1 cm while the children stood without shoes using a stadiometer (Seca Leicester, Birmingham, UK). BMI was calculated and transformed into age- and sex-standardized z-scores (z-BMI) based on the French reference data [43].

### Hunger level

At the beginning of the session, the children indicated their hunger on a four-point scale ranging from (1) not hungry at all to (4) very hungry.

### Statistical analyses

To describe children's perceptions of the buffet food assortment, liking and healthiness perception of healthy versus unhealthy foods were compared using Student's T-tests. Multiple linear regression analyses were conducted to analyze the effect of the explicit and implicit hedonic scores as well as their interaction with regard to the (1) number of healthy food choices, (2) time spent to make the food choices, (3) difference between the liking ratings of the chosen and non-chosen foods (referred as $\Delta liking_{chosen\text{-}non\_chosen}$), (4) difference between the healthiness ratings of the chosen and non-chosen foods (referred as $\Delta healthiness_{chosen\text{-}non\_chosen}$), (5) difference between the liking ratings of the healthy and unhealthy foods (referred as $\Delta liking_{healthy\text{-}unhealthy}$), and (6) difference between the healthiness ratings of the healthy and unhealthy foods (referred as $\Delta healthiness_{healthy\text{-}unhealthy}$). We assumed that $\Delta liking_{chosen\text{-}non\_chosen}$ (resp. $\Delta healthiness_{chosen\text{-}non\_chosen}$) reflected the use of liking (resp. healthiness perception) as a criterion for food choice. All the participants completed the entire protocol, there was no missing data and the analyses were conducted on the total sample of 63 children. All of the multiple linear regression analyses presented in the results section included three continuous control variables: hunger level, age, and z-BMI. All statistical analyses were performed using SAS version 9.3 (SAS Institute, Inc., 2012 SAS® 9.3. Cary, NC). The level of significance was set at $P = 0.05$. The results are expressed as means ± SDs.

## Results

### Preliminary results

#### *Perception of the food assortment*

The liking and healthiness perception ratings of each buffet food are presented in Table 2. On average, the liking of healthy foods was similar to that of unhealthy foods ($M_{liking\_healthy} = 8.4 \pm 1.4$, $M_{liking\_unhealthy} = 7.9 \pm 1.5$; $t(62) = 1.73$, $P = 0.09$), whereas healthiness perception significantly differed between healthy and unhealthy foods ($M_{healthiness\_healthy} = 9.3 \pm 0.8$, $M_{healthiness\_unhealthy} = 3.7 \pm 2.1$; $t(62) = 21.0$, $P < 0.0001$). In addition, a Spearman's correlation revealed that children's health ratings were inversely linked with food ED (Spearman's $\rho = -0.68$, $P = 0.03$). High ED is an indicator of poor nutritional quality in western countries [44, 45]. Thus, children's perception of food healthiness matched an objective indicator of food nutritional quality. Moreover, no correlation was found between liking and healthiness for the 10 food items rated by the children (Spearman's $\rho = 0.12$, $P = 0.75$).

**Table 2** Liking and healthiness perception ratings of each buffet food ($n = 63$)

| | Liking | Healthiness |
|---|---|---|
| Red apple | 8.2 ± 2.2 | 9.6 ± 1.1 |
| Banana | 8.3 ± 2.4 | 9.1 ± 1.4 |
| Kiwi | 7.9 ± 3.4 | 9.3 ± 1.2 |
| Applesauce | 8.2 ± 2.8 | 9.4 ± 1.2 |
| Strawberries | 9.4 ± 1.6 | 9.1 ± 1.6 |
| Donuts | 7.1 ± 3.1 | 4.0 ± 3.3 |
| Chocolate cake | 8.0 ± 2.6 | 4.4 ± 3.2 |
| Smarties® | 8.2 ± 2.5 | 3.6 ± 2.7 |
| Kinder Bueno® | 8.4 ± 2.5 | 3.4 ± 2.6 |
| Gold Bears® | 8.1 ± 2.6 | 3.0 ± 2.9 |

Values are presented as the means ± SD

#### *Description of children's food choices*

On average, the children chose 2.2 ± 1.1 healthy foods in 55.9 ± 24.2 s. All of the children ate all the foods that they chose. The liking ratings of the chosen foods were higher than those of the non-chosen foods ($M_{liking\_chosen} = 9.1 \pm 0.87$, $M_{liking\_non\_chosen} = 7.3 \pm 1.6$; $t(62) = 8.33$, $P < 0.0001$), whereas healthiness perception did not significantly differ between the chosen and non-chosen foods ($M_{healthiness\_chosen} = 6.2 \pm 1.9$, $M_{healthiness\_non\_chosen} = 6.8 \pm 1.7$; $t(62) = -1.96$, $P = 0.055$).

#### *Description of children's attitudes toward food*

On average, children's implicit attitudes toward food were primarily hedonic-based ($M_{implicit\_hedonic\_score} = 75.7 \pm 26.6\%$), as were their explicit attitudes, to a lesser extent ($M_{explicit\_hedonic\_score} = 56.0 \pm 23.4\%$). The implicit and explicit hedonic scores were not significantly correlated with each other ($r = 0.09$, $P = 0.48$).

### Primary results

#### *Effect of explicit and implicit attitudes on children's food choices*

The number of healthy buffet foods chosen significantly increased as a function of both the implicit hedonic score ($\beta = 0.04$, *95% CI* [0.011; 0.061], $P = 0.01$) and the explicit hedonic score ($\beta = 0.05$, *95% CI* [0.015; 0.088], $P = 0.01$). The interaction between the explicit and implicit hedonic scores was also significant ($\beta = -0.001$, *95% CI* [−0.001; −0.0001], $P = 0.01$). Median splits were performed with regard to the implicit and explicit hedonic scores to create four groups of children with contrasting attitudes toward food. As Fig. 2 shows, the children with both high implicit and explicit hedonic scores chose more healthy foods, as did the children with either high implicit or high explicit hedonic scores. Conversely, children with both low implicit and explicit hedonic scores chose fewer healthy buffet foods than those from the other groups.


**Fig. 2** The effects of the relative dominance of nutrition- versus hedonic-based implicit and explicit attitudes on the number of healthy food choices. The four groups of children were created based on median splits of the implicit and explicit hedonic scores. Values are presented as the means ± SEM

### *Effect of explicit and implicit attitudes on the time spent to make food choices*

The time that children took to choose was not related to their implicit hedonic scores ($\beta = -0.23$, *95% CI* [−0.85; 0.40], $P = 0.47$) or their explicit hedonic scores ($\beta = -0.06$, *95% CI* [−0.96; 0.85], $P = 0.90$).

### *Effect of explicit and implicit attitudes on the difference between the liking or healthiness ratings of the chosen and non-chosen foods*

To further understand the relationship between the relative dominance of hedonic versus nutrition-based implicit and explicit attitudes toward food and children's food choices, the effects of the implicit and explicit hedonic scores on $\Delta liking_{chosen\text{-}non\text{-}chosen}$ and $\Delta healthiness_{chosen\text{-}non\text{-}chosen}$ were tested. On average, $\Delta liking_{chosen\text{-}non\text{-}chosen} = 1.75 \pm 1.67$ and significantly differed from zero ($P < 0.001$), and $\Delta healthiness_{chosen\text{-}non\text{-}chosen} = -0.62$ and did not significantly differ from zero ($P = 0.055$). The results of the linear regressions did not show an effect of the implicit ($\beta = 0.02$, *95% CI* [−0.03; 0.06], $P = 0.50$) and explicit ($\beta = 0.03$, *95% CI* [−0.04; 0.09], $P = 0.38$) hedonic scores on $\Delta liking_{chosen\text{-}non\text{-}chosen}$ but a significant effect of both implicit ($\beta = 0.09$, *95% CI* [0.03; 0.15], $P = 0.004$) and explicit ($\beta = 0.13$, *95% Cs* [0.04; 0.22], $P = 0.01$) hedonic scores as well as their interaction ($\beta = -0.001$, *95% CI* [−0.002; −0.0003], $P = 0.01$) on $\Delta healthiness_{chosen\text{-}non\text{-}chosen}$.

### *Effect of explicit and implicit attitudes on the difference between the liking or healthiness ratings of the healthy and unhealthy foods*

We wondered whether the above results were because the children with low implicit and explicit hedonic scores liked healthy foods less than unhealthy foods; this effect might have led to a greater number of unhealthy food choices driven by liking. The effects of the implicit and explicit hedonic scores on $\Delta liking_{healthy\text{-}unhealthy}$ were tested. No significant effect of the implicit ($\beta = 0.05$, *95% CI* [−0.003; 0.10], $P = 0.07$) or explicit ($\beta = 0.04$, *95% CI* [−0.04; 0.11], $P = 0.31$) hedonic scores on $\Delta liking_{healthy\text{-}unhealthy}$ was found. In addition, we did not observe a significant effect of the implicit ($\beta = -0.004$, *95% CI* [−0.06; 0.05], $P = 0.88$) or explicit ($\beta = -0.0003$, *95% CI* [−0.08; 0.08], $P = 0.85$) hedonic scores on $\Delta healthiness_{healthy\text{-}unhealthy}$.

## Discussion

The present study explored the relationship between children's implicit and explicit attitudes toward food. Specifically, we investigated the relative dominance of hedonic- versus nutrition-based attitudes, and children's food choices with regard to a buffet offering highly appreciated healthy and unhealthy sweet foods. To assess children's attitudes toward food, we used two tasks previously developed by Monnery-Patris et al. (2016) [34]. The implicit pairing task assessed the dominance of hedonic versus nutritional associations without criteria. This task likely assesses implicit attitudes toward food, which are defined as automatic and spontaneous [26]. In fact, implicit attitudes likely result from associative reasoning and reflect an individual's level of exposure to a given association in one's culture [46]. We assume that the implicit hedonic score from the implicit pairing task reflects passive learning of the relative dominance of hedonic versus nutritional considerations through successive food experiences. The explicit forced-choice categorization task assessed the dominance of hedonic versus nutritional categorizations when explicit classification criteria were given. This task likely assessed explicit attitudes toward food, which are defined as non-automatic and deliberative [26]. Because this task involved a direct analysis of the potential benefits of food consumption, either hedonic or nutritional, the explicit hedonic score may reflect what children are taught about food. To clearly establish a difference in the interpretation of the two tasks, we hypothesize that the implicit hedonic score reflects a passive learning and appropriation of cultural food values among children, whereas the explicit hedonic score reflects their intentional education of the hedonic and nutritional values of food through family expectations, media information about nutrition, and health promotion programs.

This study observed that both implicit and explicit attitudes significantly influenced children's food choices. We observed that children with more hedonic-based implicit or explicit attitudes toward food chose healthier buffet foods. The influence of implicit and explicit hedonic scores on food choices was also moderated by a negative interaction indicating that children who had both low implicit and explicit hedonic scores were those who chose the fewest healthy food options. These results

support Rozin et al.'s hypothesis that pleasure-oriented attitudes toward food are associated with healthier diets [38]. On one hand, we showed that the difference in liking between chosen and non-chosen foods was significantly positive, and neither implicit nor explicit hedonic scores affected this difference; in other words, children primarily chose the foods that they liked regardless of their attitudes. On the other hand, we showed that the difference in healthiness perception between the chosen and non-chosen foods was negative but not significantly different from zero; furthermore, this difference increased as a function of both implicit and explicit hedonic scores. Thus, when their implicit and explicit hedonic scores decreased, children chose the foods they perceived as less healthy, even though that they liked the healthy and unhealthy buffet foods equally.

Children with high hedonic scores chose healthier food options from a buffet offering similarly liked healthy and unhealthy foods. In this particular condition, having hedonic-based attitudes might have driven healthy food choices. In fact, hedonically oriented children chose the foods that they liked without considering the healthiness of foods, leading to a balanced choice of healthy and unhealthy food items. Conversely, children with both low implicit and explicit hedonic scores chose more unhealthy buffet food items and did not report a higher liking for unhealthy foods. Being unhealthy per se likely made unhealthy foods more attractive to them. At first sight, it could be surprising that the children most motivated to eat unhealthy foods were those with both implicit and explicit nutrition-based attitudes. Several hypotheses might explain why such an attitudinal pattern is associated with unhealthier food choices. Based on the interpretation of the tasks, having both implicit and explicit nutrition-based attitudes might reflect both a passive learning of and an intentional education about the nutritional value of foods in children [34]. This effect might be because of particular nutrition-focused familial contexts associated with restrictive parental feeding practices that enhanced children's motivations to eat unhealthy foods during the experiment. For instance, children's desire for a food increases significantly when its access is prohibited [47], and children consume more of a formerly forbidden food when they are finally allowed to eat it [48]. Children with both implicit and explicit nutrition-based attitudes might have a restricted access to unhealthy foods at home which consequently increased their selection and intake of these foods in the context of this experiment. In fact, the experimental session occurred in the absence of a parent and might have been perceived as particularly tempting because numerous highly appreciated sweets were available. Perceived restrictive parental feeding practices were not recorded in the present study. Additional research is needed to investigate the psychological and environmental factors associated with this nutrition-focused pattern of attitudes toward food in children. To avoid any potential counter-productive effect of this nutrition-focused attitudinal pattern, we suggest that shaping hedonic-based attitudes toward food by enhancing the attractiveness of healthy foods using pleasure-based strategies could be efficient to drive healthy food choices in children [40].

From a theoretical perspective, the present study was the first to investigate the ways that both implicit and explicit attitudes toward food predict children's food choices. We found an interaction between implicit and explicit attitudes with regard to their influence on children's buffet food choices, supporting the multiplicative predictive model [28]. Although the attitudes measures differed, this result is consistent with König et al. [31] who found a negative interaction between the effects of implicit and explicit attitudes on food choice using a multiple-option choice task involving the choice of a meal at a fake foods buffet. These authors specifically recorded the total amount of self-served sweets and fruit as well as studied their relationships with implicit and explicit attitudes toward these foods. König et al. highlighted a compensatory "one attitude is sufficient" effect because more sweets than fruit were chosen when at least one attitude (either implicit or explicit) showed a preference for sweets over fruit. Similarly, we found that when either the implicit or explicit hedonic score was high, children chose more healthy foods.

### Strengths and limitations

One strength of this study was its assessment of actual food choices among children in an ecologically valid eating situation. In fact, 80% of French 3- to 17-year-olds have a snack in the afternoon at least 4 times a week [49]; thus, snacking is a common practice. A limitation of the protocol is that the study occurred in a laboratory, which might have biased children's food choices. Nevertheless, the laboratory context allowed us to accurately control certain environmental parameters. It ensured that each child made his or her own food choices under the same conditions so that these choices could be properly compared. Regarding food assortment, we chose highly liked healthy and unhealthy foods. Although both healthy and unhealthy foods were displayed in the buffet without packaging, certain unhealthy foods might have been recognized as branded products that may have influenced children's food choices. Moreover, this particular assortment of food questions the generalizability of our findings. Notably, one may wonder whether implicit and explicit hedonic scores would have similarly predicted healthier food choices if the healthy food items had been less liked (e.g., if we had chosen vegetables

instead of fruit). The answer might be negative. Knowing that liking was a strong predictor of children's food choices independent of their implicit and explicit hedonic score, offering foods with contrasted liking could have driven all of the children to the same choice: they would have chosen the foods they liked (i.e., the unhealthy options). Thus, offering similarly liked healthy and unhealthy foods is strength of our experimental design because it enabled us to observe a fine tuning of food choices based on attitudes toward food. Moreover, the age range was quite large and it might have affected the results. The age of the participants was included as a control variable in all the statistical analyses (Additional file 1). However, the effect of age on children's food choices was not significant. Thus, the wide age range strengthens the assumption that food choices were primarily influenced by children's attitudes rather than by their age. The same is also true for z-BMI, also included as a control variable in all the statistical analyses (Additional file 1). Finally, in line with previous studies, we assumed that the implicit pairing task and the explicit categorization task measured the implicit and explicit relative dominance of hedonic- versus nutrition-based attitudes toward food, respectively [33, 34]. However, the implicit pairing task is likely to have captured something else than strictly speaking hedonic or nutritional aspects of food. In fact, pairing two meats together because "they are both meats" could reflect nutritional considerations but also usage (e.g., two meats are interchangeable within a meal, because they belong to the same food category). Conversely, pairing two foods together because they are good together could reflect hedonic considerations but also habits. However, there is still an opposition between cognitive associations (i.e., pairing two similar foods according to their taxonomic status) and affective associations (i.e., pairing two complementary foods reflects the anticipation of food consumption and of pleasure which may derive from it).

## Conclusion

Contrary to common belief, our experiment showed that having hedonic-based attitudes toward food predicted healthier food choices in children, whereas consistent implicit and explicit nutrition-based attitudes were associated with fewer healthy food choices from a buffet offering highly liked sweets of contrasting nutritional quality. These findings indicate that pleasure from eating could be an ally more than a threat regarding healthy eating in children, at least when liked healthy foods are available. These results are of particular interest from a public health perspective because they indicate that hedonic-based attitudes might be a lever to enhance healthy eating behaviors among children. It now appears important to develop further research to understand the etiology of children's attitudes toward foods in order to provide insights on how to shape adequate children's attitudes to guide them toward healthy food choices.

## Additional file

**Additional file 1:** Complete description of the multiple linear regression analyses. The Additional file 1 presents the results of the 5 multiple linear regression analyses including the DF, F-value, $P > F$, β, 95% CI and $P > |t|$ for the three variables of interest, namely the implicit score, the explicit score and the interaction between the scores, and for the three control variables, namely age, z-BMI and hunger level. (DOCX 26 kb)

### Abbreviations

z-BMI: Body mass index z-score; ED: Energy density

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### Availability of data and materials

The datasets analyzed during the current study are available from the corresponding author.

### Authors' contribution

LM performed the experimental sessions, completed the statistical analysis and drafted the manuscript. MM performed the experimental sessions. MB assisted with participant recruitment. All of the authors contributed significantly to the design of this study, to the interpretation of the findings and to a critical revision of the manuscript. All of the authors read and approved the final manuscript.

### Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and approved by the local ethical committee (Comité pour la Protection des Personnes EST-1 Burgundy, file number: 2015-A01547–42). Written informed consent was obtained from parents before their child's participation in the study. We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were adhered to during this research study.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

## Publisher's Note



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# CHAPITRE 5 : CONTEXTES SANTE/PLAISIR ET CHOIX ALIMENTAIRE CHEZ L'ENFANT

# Article 5

**When do healthiness and liking drive children's food choices? The influence of social context and weight status**

**Marty L.**, Nicklaus S., Miguet M., Bournez M., Chambaron S., Monnery-Patris S.

*Soumis à Appetite*

## OBJECTIFS & PRINCIPAUX RESULTATS

L'objectif de l'**Article 5** était d'étudier l'influence de contextes sociaux fictifs mobilisant des considérations en lien avec le plaisir ou la nutrition sur les intentions de choix alimentaires des enfants normo-pondéraux et en surpoids.

Indépendamment de leur statut pondéral, les enfants ont effectué des choix alimentaires de meilleure qualité nutritionnelle dans le contexte social orienté santé, comparé au contexte social orienté plaisir.

**Title:** When do healthiness and liking drive children's food choices? The influence of social context and weight status

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## ABSTRACT

Children identify liking and healthiness of foods as factors influencing their food choices. However, the food decision making process is also influenced by both personal characteristics and food contexts. The present study explored the influence of liking and perceived healthiness of foods in normal- and overweight children's food choices intentions in a pleasure-oriented social eating context and a health-oriented social eating context. Children aged from 6 to 11 years old (n=63; 34 normal- and 29 overweight children) were asked to select 5 foods among 10, based on food pictures, to make up a snack that would be suitable for their *birthday party* or a *nutrition class*. In addition, they rated their liking and healthiness perception of the foods. Normal- and overweight children made similar food choices in both social contexts suggesting that they share the same social eating norms attached to a birthday party and a nutrition class. A health-oriented social context significantly increased the number of healthy food choices compared to a pleasure-oriented social context. Moreover, only liking significantly predicted food choices in the pleasure-oriented social context whereas both healthiness and liking significantly predicted food choices in the health-oriented social context. Overall these results advance our understanding on how normal- and overweight children make food decisions and inform strategies that may help children to adopt a healthy diet. Because liking predicted children's food choices in both eating contexts, emphasizing the "good" taste of healthy foods and providing children with healthy foods they like seem to be efficient strategies to promote healthy eating habits in children.



**Keywords:** weight status, eating context, food choices, children, liking, healthiness

## INTRODUCTION

Food likes and dislikes are known to be strong predictors of children's food choices (Birch, 1999; Birch, 1979). However, children's food preferences generally do not align with dietary recommendations: children typically rate energy-dense foods as the most liked and vegetables as the least liked foods (Cooke & Wardle, 2005; Drewnowski, 2009; Gibson & Wardle, 2003; Nicklaus, Boggio, & Issanchou, 2005; Russell & Worsley, 2007). To encourage children to adopt a healthy diet, parents, caregivers, and national campaigns display nutritional information (Hercberg, Chat-Yung, & Chauliac, 2008). In this context, children acquire an early awareness about both the hedonic and nutritional values of food. Five-year-olds are able to classify food products considering both nutritional and hedonic perceptions (Varela & Salvador, 2014). However, surprisingly sparse research has examined the relative influence of perceived healthiness and liking for food on children's food choices (Nguyen, Girgis, & Robinson, 2014).

According to the Food Standard Agency, "food choice" is defined as "the selection of foods for consumption, which results from the competing, reinforcing and interacting influences of a variety of factors" (Food Standard Agency, 2004). In fact, previous studies have identified numerous factors influencing children and adolescent's food choices including physiological (e.g., hunger), psychological (e.g., mood, food cravings), social (e.g. parent support, peers approval) and environmental (e.g., availability at home, advertising) factors (Cullen et al., 2003; Frazier, Gelman, Kaciroti, Russell, & Lumeng, 2012; Halford, Boyland, Hughes, Oliveira, & Dovey, 2007; Holsten, Deatrick, Kumanyika, Pinto-Martin, & Compher, 2012; Lumeng, Cardinal, Jankowski, Kaciroti, & Gelman, 2008; Neumark-Sztainer, Story, Perry, & Casey, 1999; Strasburger, 2006). In a constructionist perspective, all of these influences shape a personal food system that includes the values that people weigh in food choice decisions

such as taste, health, cost, time or social relationship (Connors, Bisogni, Sobal, & Devine, 2001).

Interestingly, qualitative studies have shown that liking and healthiness perceptions were perceived by children as factors influencing their food choices (Fitzgerald, Heary, Nixon, & Kelly, 2010; McKinley et al., 2005). However, in a recent study on 4- and 6-year-old children, it has been shown that healthiness ratings were not associated with declared willingness to eat a food (i.e., yes or no) whereas liking ratings were (Nguyen et al., 2014). On the basis of yes or no general decisions, the authors concluded that taste matters more than health in children's food selection. Yet, the variability with regard to food choice criteria (i.e., tastiness and/or healthiness) across eating contexts and individuals remains to be explored. In everyday life, children's food selection may depend on a particular eating context that can impact food decision (Connors et al., 2001; Larson & Story, 2009). Moreover, children's individual characteristics (e.g., weight status) may modulate the effect of perceived healthiness and liking on food decision making (Contento, Michela, & Williams, 1995).

In fact, in children aged 11-12 years and adolescents aged 16-18 years, Contento et al. (1995) observed that despite they typically ate the foods they liked, high weight individuals were more likely to declare that they frequently consume foods they believed healthy than were low weight individuals. Furthermore, eating often occurs in a social context and there is ample evidence that social norms about eating have a powerful effect on food choices in a social eating context (Higgs, 2015; Higgs & Thomas, 2016). Social norms are codes of conduct that provide a guide to appropriate action in a given context. Connors et al. (2001) assume that eating contexts allowed for prioritizing values in particular settings. Thus, we hypothesize that the social norms attached to a particular social eating context could influence which food values (e.g., healthiness or tastiness) are taken into account in the food choice decision process.

The present study explored the relative influence of liking for food and perceived healthiness in normal- and overweight children's food choices intention in two social contexts putting forward either pleasure or health. We hypothesized that liking might be the most important driver of food choices in a pleasure –oriented context, whereas it might be perceived healthiness in a health-oriented context. Moreover, we hypothesized that overweight children, known to be more focused on the nutritional value of food and more restrained than normal-weight children (Carnell, Benson, Pryor, & Driggin, 2013; Marty, Chambaron, Bournez, Nicklaus, & Monnery-Patris, 2017), might be influenced by their perceived healthiness of food in their choices to a larger extent than normal-weight children.

## SUBJECTS AND METHODS

### Participants

A total of 63 children participated in this study (mean age = 9.0, range = 6.3–11.5 years, 31 females, 32 males). Specifically there were 34 normal-weight children (mean age = 9.0, range = 6.3–11.5 years, mean zBMI = 0.22, range = -1.75–1.94, 21 females, 13 males) and 29 overweight children (mean age = 9.0, range = 6.3–11.3 years, mean zBMI = 3.39, range = 2.00–5.75, 10 females, 19 males). Children were recruited from a population registered in the Chemosens Platform's PanelSens database. This database has been declared to the relevant authority (Commission Nationale Informatique et Libertés – CNIL – n°1148039). Some overweight children were specifically recruited from pediatric weight care consultations at the Dijon public hospital. The study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethical committee (Comité pour la Protection des Personnes EST-1 Burgundy, file number: 2015-A01547-42). On the basis of a recruitment questionnaire, children having food allergies were excluded. Written informed consent was obtained from parents before their child's participation in the study. We certify that all applicable institutional and governmental regulations concerning the ethical use of human

volunteers were adhered to during this research study. The children received a certificate of attendance and their parents a €20 voucher to thank them for their participation in the study which involved other tasks not reported here.

**Food choices intentions in two fictive contexts: a pleasure- and a health-oriented context**

Based on food pictures, the children were asked to make up a snack that would be suitable in a pleasure-oriented social eating context (i.e., their birthday party: "Today it's your birthday! Choose five foods to make up a delicious snack for all of your friends.") or in a health-oriented social eating context (i.e., a nutrition class: "Today you have a nutrition class at school! Choose five foods to make up a healthy snack for all of your classmates.").

We selected 10 sweet foods, including 5 healthy foods (red apple, banana, kiwi, applesauce and strawberries) and 5 unhealthy foods (donut, chocolate cake, Smarties®, Kinder Bueno® and Gold Bears®) based on pre-testing of children's familiarity with these foods. These pre-tests were conducted with 61 children of similar age (mean age = 8.0, range = 5–12 years) recruited in children's holiday centers and only pictures of foods tried at least by 90% of the children were selected. The foods were classified as healthy or unhealthy based on their energy density (ED) (mean $ED_{healthy}$ = 57.4±20.9 kcal/100g, mean $ED_{unhealthy}$ = 442±75.8 kcal/100g) because high ED is considered as an indicator of poor nutritional quality in western countries (Drewnowski, Monsivais, Maillot, & Darmon, 2007; Rolls, Drewnowski, & Ledikwe, 2005).

A face-to-face interview was conducted with each child. A set of 20 pictures (two of each of the 10 selected foods) was placed on a table between the experimenter and the child in a predefined disposition: two pictures of each food on four rows by five columns with alternatively healthy and unhealthy foods (**Figure 1**). For each social context, the children were asked to select five food pictures. The number of healthy foods chosen was recorded.

**Figure 1.** Example of a food pictures disposition during a face-to-face interview

## Health and taste ratings

During the face to face interviews, children were also asked to rate the perceived healthiness and their liking for the 10 foods based on the same pictures. After having chosen the five foods they would like in the birthday party condition, children were presented with the 10 food pictures, one at a time, and asked to rate their liking (i.e., "How much do you like this food?") using a continuous scale (from "I don't like it at all" to "I like it very much", coded from 0 to 10, **Figure 2A-C**). Then, after having chosen the five foods they would like in the nutrition class condition, they were presented again with the 10 food pictures and asked to rate their perceived healthiness (i.e., "How much is this food healthy?") using a continuous scale (from "It is not healthy at all" to "It is very healthy", coded from 0 to 10, **Figure 2B-C**).

**Figure 2.** Pictures of the scales used to assess liking (A) and perceived healthiness (B) in children. The pictures A and B show the children side of the scales and the picture C shows the experimenter side (conversion of the rating into a 0 to 10 measure).

### Children's anthropometrics

Weight (kg) was measured with the child wearing light clothes and no shoes to the nearest 0.1 kg using a digital scale (Soehnle, Benfeld, Germany); height (cm) was measured to the nearest 0.1 cm with the child in a standing position without shoes using a stadiometer (Seca Leicester, Birmingham, UK). Body mass index (BMI) was calculated and transformed into age- and sex-standardized z-scores (z-BMI) based on the French reference data (Rolland-Cachera et al., 1991). Children were considered overweight if z-BMI>2.

### Statistical analysis

The first statistical analysis aimed at comparing liking and perceived healthiness rating for healthy and unhealthy foods between normal- and overweight children. The effect of weight status (i.e., normal-weight and overweight, between subjects), objective healthiness of the foods (i.e., healthy and unhealthy foods, within subject), and the interaction between weight status and objective healthiness were tested on both children's liking and perceived healthiness ratings. Generalized linear models with the child effect considered as random were applied.

The second statistical approach aimed at testing the effect of weight status (i.e., normal-weight and overweight, between subjects), fictive social context (i.e., birthday party and nutrition class, within subject), and the interaction between weight status and social context on the number of chosen healthy foods, and on the mean liking rating and the mean

156 healthiness rating for the chosen foods. Generalized linear models with the child effect
157 considered as random were applied.

158 In the third statistical approach, we analyzed the predictive value of liking and healthiness
159 ratings for children's healthy food choices in each context. An individual global liking score
160 was calculated as the difference between the average liking rating for healthy foods and the
161 average liking rating for unhealthy foods. A positive global liking score indicated a preference
162 for healthy foods over unhealthy foods. Similarly, an individual global healthiness score was
163 calculated as the difference between the average healthiness rating for healthy foods and the
164 average healthiness rating for unhealthy foods. A positive global healthiness score indicated
165 that healthy foods were actually perceived as healthier than unhealthy foods. We conducted
166 an analysis of covariance (ANCOVA) that included global liking score, global healthiness
167 score, participants' weight status, the interaction between global liking score and participants'
168 weight status, and the interaction between global healthiness score and participants' weight
169 status as the predictor variables, with the number of healthy foods chosen as the outcome
170 variable. This analysis was run for both fictive contexts (i.e., the birthday party and the
171 nutrition class) separately.

172 Statistical analyses were performed by using SAS software version 9.3 (SAS Institute, Inc.,
173 2012 SAS® 9.3. Cary, NC: SAS Institute Inc.). Significance was set at $P$=0.05. When no
174 precision is given, the results are expressed as the means±SD.

175 **RESULTS**

176 **Children's liking and healthiness ratings**

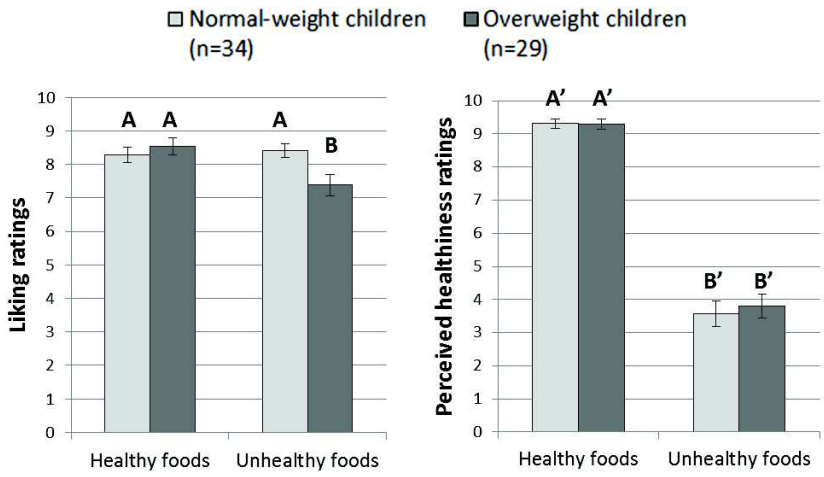
177 On average, liking ratings of the five healthy foods were similar to liking ratings of the five
178 unhealthy foods ($M_{liking\_healthy}$ = 8.4±1.4, $M_{liking\_unhealthy}$ = 7.9±1.5; $P$=0.09) whereas healthiness

179 ratings were higher for healthy foods than for unhealthy foods ($M_{healthiness\_healthy}$ = 9.3±0.8,
180 $M_{healthiness\_unhealthy}$ = 3.7±2.1, $P$<0.0001). See **Table 2** for details. The first statistical approach
181 revealed that normal- and overweight children rated similarly the healthiness of healthy and
182 unhealthy foods, that they also rated similarly their liking for healthy foods but that
183 overweight children declared to like significantly less unhealthy foods than normal-weight
184 children (**Figure 3**).

185 **Table 2.** Liking and healthiness ratings for each food (n=63)

| | Liking ratings | Healthiness ratings |
|---|---|---|
| *Healthy foods* | | |
| Red apple | 8.2±2.2 | 9.6±1.1 |
| Banana | 8.3±2.4 | 9.1±1.4 |
| Kiwi | 7.9±3.4 | 9.3±1.2 |
| Applesauce | 8.2±2.8 | 9.4±1.2 |
| Strawberries | 9.4±1.6 | 9.1±1.6 |
| *Unhealthy foods* | | |
| Donuts | 7.1±3.1 | 4.0±3.3 |
| Chocolate cake | 8.0±2.6 | 4.4±3.2 |
| Smarties® | 8.2±2.5 | 3.6±2.7 |
| Kinder Bueno® | 8.4±2.5 | 3.4±2.6 |
| Gold Bears® | 8.1±2.6 | 3.0±2.9 |

186 *Values are means±SD.*




187

188 **Figure 3.** Comparison of liking and perceived healthiness ratings for healthy and unhealthy
189 foods between normal- and overweight children. Least squares means post-hoc tests were
190 performed per outcome: means with the same letter are not significantly different.

191 **Effect of weight status and social eating contexts on children's food choices**

192 In the fictive birthday party context, children chose 1.9±1.3 healthy foods on average
193 (normal-weight children: 1.8±1.2, overweight children: 2.1±1.4, $P$=0.35). In the fictive
194 nutrition class context, children chose 4.2±1.1 healthy foods on average (normal-weight
195 children: 4.3±0.94, overweight children: 4.0±1.2, $P$=0.33).

196 For the number of healthy foods chosen, a significant effect of social context [$F$(1, 61)=114.8,
197 $P$<0.0001], but non-significant effects of weight status [$F$(1, 61)=0.01, $P$=0.92] and of the
198 interaction [$F$(1, 61)=1.81, $P$=0.18] were observed. For the mean liking rating for the chosen
199 foods, non-significant effects of social context [$F$(1, 61)=3.75, $P$=0.06], of weight status [$F$(1,
200 61)=0.067, $P$=0.42] and of the interaction [$F$(1, 61)=0.28, $P$=0.60] were observed. For the
201 mean healthiness rating for the chosen foods, a significant main effect of social context [$F$(1,
202 61)=86.2, $P$<0.0001], but non-significant effect of weight status [$F$(1, 61)=0.00, $P$=0.98] and

of the interaction [$F(1, 61)=2.25$, $P=0.14$] were observed. These results are summarized **Figure 4**.

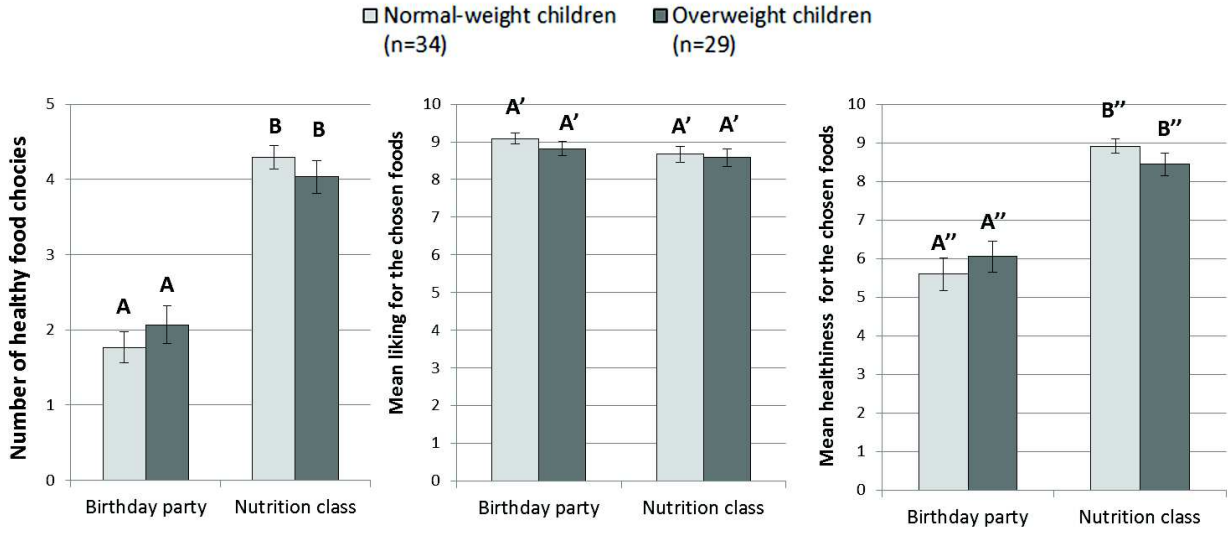



**Figure 4.** Number of healthy food choices, mean liking rating and mean healthiness rating of the chosen foods in normal- and overweight children and in both social contexts. Least squares means post-hoc tests were performed per outcome: means with the same letter are not significantly different.

These results from the second statistical approach showed that both normal and overweight children chose significantly more healthy foods in the nutrition class context compared to the birthday party context. Moreover, both normal- and overweight children similarly liked the foods they chose in both contexts but perceived their food choices as healthier in the nutrition class context compared to the birthday party context.

**Influence of liking and healthiness ratings on children's food choices**

In the fictive birthday party context, only global liking score (β estimate = 0.44±0.09) significantly predicted the number of healthy food choices. In the fictive nutrition class context, both global liking score (β estimate = 0.12±0.08) and global healthiness score (β

219 estimate = 0.25±0.08) predicted the number of healthy food choices. Weight status did not
220 influence the number of healthy food choices, and none of the interaction terms was
221 significant. The results of the third statistical approach are presented **Table 3**.

222 **Table 3.** Predictors of the number of healthy food choices (ANCOVA: Type III sums of
223 squares)

| | Number of healthy food choices | | | |
|---|---|---|---|---|
| | Fictive birthday party ($R^2$ = 0.38) | | Fictive nutrition class ($R^2$ = 0.30) | |
| Predictors | *F-value* | *P > F* | *F-value* | *P > F* |
| Liking score | 24.7 | <0.0001 | 4.48 | 0.039 |
| Healthiness score | 0.91 | 0.35 | 19.2 | <0.0001 |
| Weight status | 0.60 | 0.44 | 0.29 | 0.59 |
| Liking score × weight status | 1.97 | 0.17 | 0.02 | 0.90 |
| Healthiness score × weight status | 0.23 | 0.64 | 0.00 | 0.99 |

224

225 **DISCUSSION**

226 To our knowledge, this is the first study to investigate the effect of weight status and social
227 context on children's food choices, in particular how weight status and social contexts may
228 modulate the influence of liking and healthiness perception on children's food choices. The
229 results showed that a health-oriented social context (i.e., a fictive nutrition class) significantly
230 increased the number of healthy food choices compared to a pleasure-oriented social context
231 (i.e., a fictive birthday party) in both normal- and overweight children. No significant
232 difference in food choices was found between normal- and overweight children. Moreover,
233 we showed that only liking significantly predicted food choices in a pleasure-oriented social
234 context whereas both healthiness perception and liking significantly predicted food choices in
235 a health-oriented social context. The influence of liking and healthiness perception on
236 children's food choices did not depend on their weight status. Thus, we highlighted that the

prediction of children's food choices by liking or healthiness perception could vary across social contexts but was stable across weight status.

No difference was found regarding the food choices of normal- and overweight children. The results revealed a similar perception of healthiness of foods in normal- and overweight children and no difference in their liking for healthy foods, but overweight children declared that they liked less unhealthy foods than normal-weight children which may seem counter-intuitive. This difference could be explained by a social desirability effect. It has been advanced that awareness of the social stigma attached to obesity led overweight adolescents to downplay their liking for unhealthy foods (Diehl, 1999; Perl, Mandić, Primorac, Klapec, & Perl, 1998). However, this difference did not translate into different food choices among the two groups of children. In the present study, the children were asked to make up a snack suitable for a social eating context so children's food choices were likely to reflect what was expected by themselves and others in such contexts (Higgs & Thomas, 2016). The fact that normal- and overweight children made similar food choices in both contexts could reflect that they shared the same social eating norms with regard to a birthday party and a nutrition class. Even if overweight children declared liking less unhealthy foods than normal-weight children – which may reflect either an actual lower liking or their knowledge of which food would be "good" for them – they picked a similar number of unhealthy foods in the birthday party condition compared to normal-weight children. This may highlight the difficulty of overweight children to adjust their food choices to what they think is "good" for them in social contexts where pleasure is valued.

The pleasure-oriented eating context led to a larger number of unhealthy food choices than the health-oriented eating context in children. Moreover, the comparison of the mean healthiness rating for the chosen foods in both contexts showed that children were primed by the context as they chose foods they actually perceived healthier in the health-oriented context than in the

pleasure-oriented context. However, the comparison of the mean liking rating for the chosen foods in both contexts showed that children similarly liked the food they chose in both contexts. These results suggest that children did not experience any hedonic cost in choosing foods with an improved health value in our experimental conditions. Indeed, the assortment of foods was chosen to be contrasted in terms of children's healthiness perception but similar regarding liking. Despite children's similar liking of healthy and unhealthy foods presented in our experimental setting, in the pleasure-oriented eating context the children chose more unhealthy foods. It suggests that a "delicious" snack suitable for a birthday party was not only a snack they liked but also a snack that corresponded with habits and social norms attached to this particular eating situation.

The study of the predictors of healthy food choices in children highlighted that having a higher liking for healthy foods compared to unhealthy foods led to healthier food choices in both a pleasure-oriented and a health-oriented eating context. Moreover, perceiving healthy foods as actually healthier than unhealthy foods led to healthier food choices only in a health-oriented eating context (i.e., when the eating context explicitly appealed to health considerations). In line with past research, and despite a low variability in the liking ratings of the food assortment, our results confirmed that liking had a major influence on children's food selection (Birch, 1979; Contento, Michela, & Williams, 1995; Nguyen et al., 2014). Moreover, we highlighted that a health-oriented context acted as a nudge that made salient the health value of foods while children were selecting a snack, leading to healthier food choices. Indeed, in order to choose the most valuable food option, individuals use their personal food value system that includes several food-related values (e.g., taste, health, cost, convenience) (Rangel, 2013; Sobal & Bisogni, 2009). In line with previous results in adults (Connors et al., 2001), we demonstrated that, in children as well, the salience of these two values, tastiness and healthiness, varied across eating contexts. However, the influence of liking and

287 healthiness on children's food choices did not depend on their weight status. This result does
288 not support the findings of Contento et al. (1995) which showed that health evaluation of
289 foods were associated with declared food choices in a larger extent in overweight than in
290 normal-weight adolescents. One explanation of this discrepancy is that, in the present study,
291 children were asked to make up a snack "for their friends" or "for their classmates". Hence,
292 children's food choices were more likely to reflect what children thought it was expected by
293 others rather than what they would have chosen for themselves. Social norms might have
294 overcome overweight children's personal motivations in the food decision process. The
295 influence of this kind of paradoxical situation on food choices, which may lead to a conflict
296 between food values, remains to be further investigated, particularly in overweight children.

297 **Strengths and limitations**

298 The present study has several limitations. First, we investigated food choices intentions in two
299 fictive eating contexts, which may not be reflective of what the children would have chosen in
300 a real birthday party or nutrition class. Nonetheless, the first part of the experimental session,
301 not reported here, involved actual food choices for an actual afternoon snack based on the
302 same food items. Thus, children were interviewed in a context where making food choices
303 made sense for them. Moreover, we asked the children to make up a snack for other children
304 which may have limited the effect of their weight status on their food choices. However, it
305 allowed to examine what are the social norms attached to each social eating context in terms
306 of food options. Finally, the particular assortment of food questions the generalizability of our
307 findings. In particular, we found that children did not experience any hedonic cost in choosing
308 foods with an improved health value in our experimental conditions; it is likely that it would
309 not have been the case if the healthy food items had been less liked than the unhealthy food
310 items. However, this experimental setting is also a strength of our study because it allowed to
311 highlight that some healthy foods can be highly appreciated by children, as are unhealthy

foods. Another strength of this study is the validation of a new tool to measure healthiness perception of food in 6-to-10-year-old children. In fact, Spearman's correlation revealed that children's healthiness ratings were inversely linked with foods ED (Spearman's $\rho$ = -0.68, $P$ = 0.03). Moreover, numbers of research studies have compared appetitive traits of normal- and overweight children, such as food preference, food cue sensitivity, satiety sensitivity, self-control capacity (for reviews see: Carnell, Benson, Pryor, & Driggin, 2013; van Meer, Charbonnier, & Smeets, 2016). However, the literature is sparse with regard of the comparison of normal and overweight children's actual food choices. Thus, the present study adds some new insights to the field of the study of children's eating behaviors.

## CONCLUSIONS

Overall the results of the present study advance our understanding on how normal- and overweight children make food decisions. This may inform strategies intended to help children to adopt a healthy diet. In fact, we demonstrated that children having higher liking for healthy foods over unhealthy foods performed healthier food choices in both eating contexts tested in this study, whereas knowledge about which food is healthy or not only predicted healthier food choices when the eating context explicitly appealed to think about health. Thus, emphasizing the "good" taste of healthy foods and providing children with healthy foods they like may be efficient strategies to promote healthy eating in children whatever the eating context.

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341 **Author contributions**

342 LM performed the experimental sessions, completed the statistical analysis and drafted the
343 manuscript. MM performed the experimental sessions. All the authors helped designing the
344 study protocol and interpreting the findings, and they made a critical revision of the
345 manuscript. All the authors read and approved the final manuscript.

346

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# Article 6

**Non-conscious effect of food odors on children's food choices varies by weight status**

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## OBJECTIFS & PRINCIPAUX RESULTATS

L'objectif de l'**Article 6** était d'étudier l'influence de contextes olfactifs (i.e., odeurs alimentaires de poire et de quatre-quarts non-attentivement perçues) sur les intentions de choix alimentaires des enfants normo-pondéraux et en surpoids.

Les résultats ont montré une interaction entre le statut pondéral et l'amorce olfactive : chez les enfants normo-pondéraux les amorces olfactives « poire » et « quatre-quarts » augmentaient toutes deux la fréquence de choix d'un aliment gras et sucré comparé à une condition contrôle sans odeur, tandis que chez les enfants en surpoids l'amorce olfactive « poire » augmentait la fréquence de choix d'un fruit comparé à la condition contrôle.

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ORIGINAL RESEARCH
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# Non-Conscious Effect of Food Odors on Children's Food Choices Varies by Weight Status

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**Objective:** Food cues are omnipresent in the daily environment and may influence eating behavior even non-consciously. An increased reactivity to food cues, such as food odors, has been shown to be correlated with obesity in children. The objective of this study is to investigate whether the non-conscious influence of food odors on children's food choices varies by their weight status.

**Methods:** Seventy-four children, of whom 29 were obese, took part in this study. The children performed a food choice intention task presented as a computer game in which 30 pairs of food images (a fatty-sweet food picture vs. a fruit picture) successively appeared on the screen. The children had to choose the item "they most wanted to eat at the present moment" for each pair. While performing this task, the children wore a headset in which the microphone foam was odorized with a fruity odor, a fatty-sweet odor or no odor. They performed the intention task three times, one time for each olfactory condition. The odors were non-attentively perceived, i.e., none of the children were aware of the odorization of the microphone foams. The modeled probability is the probability to choose a fruit.

**Results:** In children with obesity, the fruity odor increased the likelihood of a fruit to be chosen compared to the no-odor condition [OR (95% CL) = 1.42 (1.13–1.78), $P = 0.0028$], while the fatty-sweet odor had no effect on food choice [OR (95% CL) = 1.07 (0.85–1.36), $P = 0.55$]. In children without obesity, both the fruity and the fatty-sweet odors decreased the likelihood to choose a fruit compared to the no-odor condition [OR (95% CL) = 0.76 (0.64–0.90), $P = 0.0015$, for the fruity odor and OR (95% CL) = 0.79 (0.66–0.93), $P = 0.0062$, for the fatty-sweet odor].

**Conclusion:** The different patterns of results obtained in both groups of children suggest differences in the mental representations activated by non-attentively perceived olfactory cues based on weight status.

**Keywords: priming, odors, food choices, obesity, children**

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## INTRODUCTION

Current research in social and cognitive psychology suggests that environmental stimuli can have an effect on information processing and behavior, even when people are not aware of these influences (1, 2). Eating behavior is no exception to this rule. Many cues related to food (e.g., odors, images, and messages) are omnipresent in the daily environment and may affect eating behavior. People are

often not even aware of the presence of these cues, and they are even less aware of the impact that such cues can have on their own eating behavior (3–5).

In everyday life, children are surrounded by food cues, whether they are on TV, the internet, or the street in the form of a billboard or a fast-food restaurant. This constant exposure to palatable energy-dense food cues is noted to be one of the factors responsible for the current obesity epidemic (6–8). Despite the fact that children are highly exposed to such food cues, there is a wide variation in their body weight, suggesting different patterns of response to an obesogenic environment. Obesity in childhood requires particular attention considering that children with obesity are more likely to remain obese into adulthood and to develop diabetes and cardiovascular diseases at a younger age (9). Among the food cues that could influence children's eating behavior, food odors are of particular interest. Indeed, the olfactory bulb has direct connections with the amygdala and hippocampus – two brain areas strongly implicated in emotion and memory (10). This may explain why olfaction is successful at triggering emotions and memories and useful to impact food choice behavior (5). Moreover, from a classical conditioning perspective, the more frequently a cue is associated with a behavior in daily life, the more likely the cue is to prompt this particular behavior. Yet, a food odor is most of the time related to an actual eating situation, more than a visual cue for instance. Children are used to seeing a lot of food pictures outside an eating context, such as on TV, or on the internet, but when they smell food it is usually because someone is cooking for them, or they get in a restaurant or in a bakery where they will actually choose something to eat. Thus, food odors are directly associated with eating situations and then can be viewed as strong predictors of eating behaviors. Moreover, this conditioned association between food odor cues and eating behavior might be stronger in obese than in normal-weight children because they show higher external eating trait, meaning that their eating behavior is more often triggered by food cues (11, 12). Thus, it might be assumed that this strengthened link between food cues and behavior would make food odors more predictive of food choices in obese children. The key point of this study is to focus on the non-conscious influence of food odors on children's food choices based on their weight status.

To our knowledge, only two experimental studies have compared the responsiveness for attentively perceived food odors in children based on their weight status (13, 14). In one study, obese children between 8 and 12 years consumed more palatable high-calorie foods than their lean counterparts after attentively smelling them (14), while another study found that 6- to 11-year-old children with obesity showed increased lip sucking in response to an attentive exposure to both high-energy food pictures and food odors (13). Thus, attentively perceived food odors seem to differentially affect children's eating behavior based on their weight status. However, the influence of non-attentively perceived food odors on children eating-related behavior based on weight status has never been investigated. Yet, there are strong evidences in the literature that an eating behavior can also be triggered by non-attentively perceived food cues (3, 4) and especially food odors (5). Thus, investigating the influence of non-attentively perceived food odors in children with and without obesity could help to better understand children's eating behavior and to highlight potential psychological mechanisms underlying eating behavior that may be associated with early obesity. To explore this question, an olfactory priming paradigm was adapted to children.

The priming paradigm initially developed in cognitive psychology (15) consists of two phases. In the first phase, participants are incidentally exposed to a stimulus called a "prime," which can belong to any sensory modality (e.g., visual, auditory, olfactory). During the exposure, mental representations related to the prime are activated (16, 17). In the second phase, the unconscious effects of the activation are evaluated using indirect memory tasks (18) in which no reference is made to the prior phase. Priming effects require the participant to be unaware of the influence of the primes on later tasks (1). Primes can automatically activate associated representations in memory, leading to higher accessibility. This accessibility then spreads to related constructs via an associative network (19, 20). In line with spreading-activation theory, priming a given construct in memory leads to the spontaneous activation of related constructs in memory. In a precursor study on olfactory priming, Holland and colleagues explored the influence of a non-attentively perceived scent of citrus, typical of all-purpose cleaners, on thinking and behavior in adults (21). The results showed that the presence of citrus scent enhanced the accessibility of the behavior concept of cleaning, which was indicated by the faster identification of cleaning-related words in a lexical-decision task as well as a higher frequency of listing cleaning-related activities when describing expected behavior during the day. Moreover, it was established that exposure to the citrus scent also influenced actual performance of cleaning behavior. It is important to note that the participants were not aware of the presence of the scent or the fact that their cognition and behavior were affected by the scent. Thus, a non-attentively perceived odor (e.g., a citrus scent) can non-consciously activate a concept (e.g., the cleaning concept) that may subsequently guide behavior in adults.

In the food domain, a recent study on olfactory priming was conducted with adult participants. The study demonstrated that a non-attentively perceived odor of melon led to a faster identification of the word "melon" during a lexical-decision task and that participants who were exposed to the melon odor were more likely to choose appetizers with vegetables in a task that involved choosing from a menu (22). Two other studies investigated the influence of non-attentively perceived food odors on real food choices in adults which have shown that a pear odor increased the proportion of choices of a fruity dessert (an apple purée) whereas a chocolate-croissant odor increased the proportion of choices of a fatty-sweet dessert (a waffle) (23, 24). The authors of these studies hypothesized that a given food odor, even non-attentively perceived, activated an odor-congruent concept (i.e., a fruity odor activated the fruit and vegetables concept, while a fatty-sweet odor activated the fatty-sweet foods concept) resulting in the facilitation of odor-congruent food choices.

The investigation of fruity and fatty-sweet odors and their influence on eating behavior is particularly relevant in terms of public health. Fruit and fatty-sweet foods are distinct regarding their typical sensory properties (e.g., taste, aroma, etc.), but they are also opposite regarding their healthiness properties. Thus, in the context of increasing childhood obesity, it is of particular interest to investigate the unconscious influence of fruity versus fatty-sweet food odors on children's food choices based on their weight status. Indeed, this investigation could give insights into the psychological mechanisms that underlie obesity in children.

The main objective of the present study was to determine whether olfactory primes (a fruity and a fatty-sweet food odor) differentially influence children's food choices based on their weight status. To do so, a food choice intention task was developed. It was presented as a computer game in which children must choose "what they most want to eat at this moment" by selecting a food among pairs of pictures (a fruit vs. a fatty-sweet food). This study is the first to develop such methodology tailored for children. Considering the existing literature on the influence of attentively perceived food odors in children and the influence of non-attentively perceived food odors in adults, the most relevant hypothesis is that a fruity odor may guide children's food choices toward more fruit, whereas a fatty-sweet odor may guide food choices toward more fatty-sweet products. Moreover, an amplified effect of the olfactory primes in children with obesity, compared to children without obesity, is expected (13, 14), resulting in a larger increase in the likelihood to choose a fruit when exposed to the fruity odor and also the likelihood to choose a fatty-sweet product when exposed to the fatty-sweet food odor.

## MATERIALS AND METHODS

### Participants and Design

The children included in this study were between 6 and 11 years old, attended an elementary school, and had no food allergies. They were recruited from a population registered in the Chemosens Platform's PanelSens database. This database complies with national data protection rules and has been vetted by the appropriate authority (Commission Nationale Informatique et Libertés – CNIL – no. 1148039). Children with obesity were specifically recruited from pediatric weight care consultations at the Dijon public hospital. The study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethical committee (Comité pour la Protection des Personnes EST-1 Burgundy, file number: 2015-A01547-42). Written informed consent was obtained from parents before their child's participation in the study. All applicable institutional and governmental regulations concerning the ethical use of human volunteers were adhered to during this research study. In return for their participation, the parents received a €10 voucher.

The children and their parents were invited to a 1-h session during after-school snack time (5 p.m. to 6 p.m.). Parents were informed that their child would be served a snack in the laboratory and were asked not to offer their child a snack during the afternoon prior to the experiment. Children were tested in small groups (maximum of eight children) in individual booths in the laboratory. During the experimental session, children performed a food choice intention task on a computer while they were incidentally exposed to food odors. The food choice intention task was presented as a game in which 30 pairs of food pictures (fruit vs. fatty-sweet food pictures) successively appeared on the screen. During the task, the children wore a headset (Samar, London, UK) to listen to the instructions. The foam on the headset's microphone was odorized with either the aroma of a pear or pound cake, along with non-odorized foam that would serve as the control condition. This odorization method was inspired by the work of Leleu et al. (25). A double-blind procedure was used for odor exposure. First, to ensure that the participants would not be attentive to the olfactory cues during the experimental session, they were given a false purpose to the study, namely that the experiment was designed to examine how children process visual information. Second, the researchers who provided the headsets to the children did not know which odorant was present on the foams of the microphones. Each child performed the food choice intention task three times, one time for each olfactory condition (i.e., they saw 30 pairs of foods in each olfactory condition). Thus, the impact of the olfactory condition on food choices was tested in a within-subject design. This is the first attempt to develop a within-subject olfactory priming methodology, thus it was impossible to perform an *a priori* power calculation in order to determine the sample size needed to observe the expected effects. Nonetheless, a recent study investigated the influence of odors (but attentively perceived) on recognition of facial expressions using a within-subject design (25). The authors recruited 31 adults and saw an effect of odors on the outcome variable. In line with this study, we aimed at recruiting about 30 children in each group (with and without obesity).

The choice of the olfactory primes and the characteristics of the food pictures for the food choices intention task were determined after preliminary studies that are detailed in the following sections. The children involved in these preliminary experiments were different from those involved in the priming experiment, but they shared similar characteristics (age, gender, and weight status).

### Olfactory Primes

There were two methodological challenges regarding the olfactory primes, the aroma selection, and the appropriate concentration chosen for each odor. The pear and pound cake food aromas sold by Meilleur du Chef© (Bassussarry, France) were selected on the basis of a preliminary study that aimed to identify fruity and fatty-sweet odors well identified and liked by children. Four fruity odors (pear, wild strawberry, melon, and apple) and four fatty-sweet odors (pound cake, marshmallow, almond, and cotton candy) were initially tested with 15 children. For each odorant, they were asked to (1) rate their liking for the odor on a continuous scale (from "I don't like it at all" to "I like it very much" coded from 0 to 10), (2) describe how they felt like while smelling the odor, (3) identify the odor, and (4) identify the odor

by means of a four-alternative forced-choice identification task (**Table 1**). Concerning the fruity odors, melon, wild strawberry, and pear appeared to be good candidates as they were similarly appetizing and enjoyed and highly identified as fruity odors by the children in the study. The pear aroma was selected on the basis of previous work in adults (22, 24). Concerning the fatty-sweet odor, the pound cake aroma was selected because it was the most appetizing for the children, and it was also properly identified as a fatty-sweet odor by 70% of the children.

To expose children to these two different odorants, headset microphone foams were odorized (25). The odorization procedure was designed to (1) obtain stable odor intensity during the experiment and (2) obtain very low odor intensity such that children would not attentively perceive the odor. One hour before each experiment, the two odor solutions (15 μL) were absorbed into the polyurethane foam of the microphones of two distinct sets of headphones. The pear aroma was undiluted, and the pound cake aroma was diluted in propylene glycol to reach a concentration of $10^{-1}$ v/v. The control headsets with non-odorized microphone foam were indistinguishable from the other headsets. The subjective intensity equivalence of both odorants was evaluated by six adult raters. To ensure that the odorant application process resulted in a non-attentively perceived odor intensity, 12 children participated in a rehearsal of the entire study protocol. They were successively exposed to the three olfactory contexts (control, pear, and pound cake) in a counter-balanced order. They were then asked by a researcher to report orally what they thought about the headset and whether they noticed anything unusual with it. Only one of them had noticed the presence of an odor. Moreover, all of them were able to detect an odor when the researcher asked questions that focused their attention to it during a post test.

## Food Choice Intention Task

This task was presented as a computer game in which 30 pairs of food pictures (fruit vs. fatty-sweet food pictures) successively appeared on the computer screen. The task included a familiarization phase during which children performed three training trials. One picture appeared on the left side of the screen and another on the right simultaneously. Children had to choose "what they most wanted to eat at this moment" by selecting the appropriate food picture. They answered by pressing an identified key on the left or right side of the keyboard. For each pair of test pictures, the answer (coded 0 if the fatty-sweet food was chosen; 1 if the fruit was chosen) and the reaction time (ms) were recorded.

Pictures used for this task came from the Full4Health standardized food images database (26). The food pictures, presented as a pair, had to (1) display a fatty-sweet food and a fruit, (2) be properly identified by children, (3) be contrasted in healthiness perceived by children, and (4) be similarly liked by children. Sixty-three pictures of sweet foods (divided into two batches) were pre-tested with 61 children who were recruited in a holiday center for school children. Each child was presented with one batch of food pictures by a researcher during a face-to-face interview. For each food picture, children were asked to (1) identify the food presented, (2) rate their liking for this food on a continuous scale (from "I don't like it at all" to "I like it very much," coded from 0 to 10), and (3) rate their perception of healthiness of this food on a continuous scale (from "It is not healthy at all" to "It is very healthy," coded from 0 to 10). Only 43 food pictures were properly identified by at least 80% of the children and subsequently used for this study. The food choice intention task was programmed to randomly draw with replacement 30 pairs of one fruit picture and one fatty-sweet food picture among the 348 pairs that met the criteria of having a similar liking score (no more than a 2-point difference between the two foods presented together) and contrasted perceived healthiness (more than a 4-point difference between the two foods presented together). This means that each time the task was run (i.e., three times per child, one time for each olfactory condition) probably led to a unique combination of 30 food pairs.

**TABLE 1 | Results of the pretests to select the food olfactory primes ($n$ = 15).**

| | Liking | Feel like eating (%) | Correct free identification[a] (%) | Correct forced-choice identification[a] (%) |
|---|---|---|---|---|
| **Fruity odors** | | | | |
| Pear | 7.4 ± 2.9 | 44 | 50 | 67 |
| Wild strawberry | 8.6 ± 1.8 | 56 | 71 | 89 |
| Melon | 7.4 ± 3.5 | 50 | 33 | 100 |
| Apple | 9.1 ± 1.0 | 56 | 50 | 44 |
| **Fatty-sweet odors** | | | | |
| Pound cake | 7.4 ± 3.5 | 70 | 70 | 70 |
| Marshmallow | 8.4 ± 2.1 | 22 | 0 | 89 |
| Cotton candy | 7.5 ± 2.5 | 22 | 43 | 100 |
| Almond | 7.2 ± 2.6 | 33 | 43 | 67 |

[a]*Identification is considered as correct when a fruity odor (resp. a fatty-sweet odor) is indeed identified as a fruit odor (resp. a fatty-sweet food odor).*

## Procedure

The children entered the experiment room with the researchers while their parents remained in the waiting room. Before beginning the experiment, the content of the session was explained to the children. A researcher explained that they would be equipped with a headset for the game instructions and that they could not touch or remove the headset.

Each child was seated in an individual booth in front of a computer and equipped with the first headset (olfactory condition 1) installed by a researcher. The child then performed the first food choice intention task. When finished, a researcher removed the first headset and gave the child five boards of "Where's Waldo?" This part of the experiment was presented to the children as a new game but it was simply a distraction in order to exchange the first headset (olfactory condition 1) with the second (olfactory condition 2). After precisely 10 min, the boards were recovered and the child was equipped with the second headset (olfactory condition 2). The child performed the food choice intention task again, and this procedure was replicated a third time for olfactory condition 3.

At the end of the priming session, children answered a debriefing questionnaire designed to determine whether they had or had not suspected the real goal of the study. In particular, it aimed to confirm that children had not attentively perceived or identified

the prime. During face-to-face interviews, all the children were asked by a researcher to report what they thought about the whole experiment, what they thought about the headset, and whether they noticed anything unusual about it.

Before leaving, trained researchers measured the children (weight and height). Weight (kilograms) was measured with the child wearing light clothes and no shoes to the nearest 0.1 kg using a digital scale (Soehnle, Benfeld, Germany); height (centimeters) was measured to the nearest 0.1 cm with the child in a standing position without shoes using a stadiometer (Seca Leicester, Birmingham, UK). Body mass index (BMI) was calculated and transformed into age- and sex-standardized *z*-scores (*z*-BMI) based on the French reference data (27). Children were considered obese if *z*-BMI ≥2.

## Statistical Analysis

The three olfactory conditions were presented in a counterbalanced order. The nature of food choices was coded as 0 when the fatty-sweet food was chosen or as 1 when fruit was chosen. The olfactory condition effect (pear odor, pound cake odor, and no odor; within subjects), the weight status effect (normal-weight vs. obese, between subjects), and the interaction between olfactory condition and weight status on the nature of the food choices were tested. A generalized linear model with a binomial distribution and logit link was applied to the nature of food choices. For the olfactory condition effect, the no-odor condition was taken as reference in the model (i.e., only the two contrasts pear odor vs. no odor and pound cake odor vs. no odor were tested). Individual reaction times were transformed using a $1/Y$ transformation into reaction speed to improve the symmetry of the distribution as in Gaillet et al. research (22). The olfactory condition effect, the weight status effect and the nature of the food choices effect as well as all their interactions on reaction speed were tested. A generalized linear model with a normal distribution was applied to the reaction speed. In these two models, the child effect was considered as random, and these models were adjusted for sex and age of the children and for the order of presentation of the primes.

These models were estimated with the SAS GLIMMIX procedure from the SAS software version 9.3 (SAS Institute, Inc., 2012 SAS® 9.3., Cary, NC, USA). Significance was set at $P = 0.05$. When no precision is given, the results are expressed as the means ± SD.

# RESULTS

## Sample

Seventy-five children took part in the experiment. One participant had cold and asked to blow his or her nose during the experimental session. These data were removed from the analyses. Data from the debriefing questionnaire showed that the children were not aware of the actual goal of the study (i.e., to study the effect of olfactory priming on food choices) and that none of them had noticed the presence of an odor on the microphone foam. Consequently, none of the participants were excluded on this basis. Thus, analyses were run on a sample of 74 children; 45 of whom were normal weight, and 29 were obese with similar characteristics in terms of age and sex (**Table 2**).

**TABLE 2 | Participants' characteristics.**

| | All ($n = 74$) | Children without obesity ($n = 45$) | Children with obesity ($n = 29$) | *P* |
|---|---|---|---|---|
| Age[a] | 8.7 ± 1.6 | 8.6 ± 1.6 | 9.0 ± 1.5 | 0.23[b] |
| Sex (% girls) | 46 | 49 | 41 | 0.52[c] |
| *z*-BMI[a] | 1.44 ± 1.92 | 0.13 ± 1.05 | 3.46 ± 0.97 | <0.0001[b] |

*z-BMI, z-score of body mass index.*
[a]*Values are means ± SD.*
[b]*T-test.*
[c]*Chi-square test.*

## Food Choices

On average, the number of fruit chosen was 13.4 ± 7.6 over the 30 pairs of pictures of the food choice intention task (Q1 = 7; median = 13; Q3 = 18). See **Figure 1** for details.

The olfactory condition effect, the weight status effect, and the interaction between olfactory condition and weight status on the nature of the food choices were tested. Type III tests of the fixed effects revealed that the main effects of olfactory condition and weight status were non-significant [$F(2, 6{,}580) = 1.48$, $P = 0.23$ and $F(1, 6{,}580) = 0.79$, $P = 0.39$, respectively], but the interaction between the olfactory condition and weight status was significant [$F(2, 6{,}580) = 11.72$, $P < 0.0001$] which demonstrated a differential impact of the olfactory condition on the nature of food choices based on the child's weight status. Analyses were stratified on weight status to describe this differential effect. The results are presented **Table 3**. In normal-weight children, the pear odor as well as the pound cake odor significantly decreased the probability of choosing a fruit comparatively to the control condition. In children with obesity, the pear odor increased the probability of choosing a fruit comparatively to the control condition, but the pound cake odor had no significant effect on food choices.

## Reaction Time

On average, the reaction time was 3,547 ± 4,268 ms (Q1 = 2,220, median = 2,830, Q3 = 3,765). The olfactory condition effect, the weight status effect, and the nature of the food choices effect as well as all their interactions on reaction speed were tested. Type III tests of the fixed effects revealed that the main effects of olfactory condition, weight status, and nature of food choices on the reaction speed were non-significant [$F(2, 6{,}573) = 1.45$, $P = 0.23$; $F(1, 6{,}573) = 0.02$, $P = 0.88$ and $F(1, 6{,}573) = 1.16$, $P = 0.28$, respectively]. Moreover, none of the interactions were significant (olfactory condition × nature of the food choices: $F(2, 6{,}573) = 0.04$, $P = 0.96$; nature of the food choices × weight status: $F(1, 6{,}573) = 1.45$, $P = 0.23$; weight status × olfactory condition: $F(2, 6{,}573) = 1.18$, $P = 0.31$; olfactory condition × nature of the food choices × weight status: $F(2, 6{,}573) = 1.69$, $P = 0.19$). These results indicated that the reaction speed was not modified by the olfactory condition, by the weight status of the children nor by the nature of food choices.

# DISCUSSION

The present research aimed at exploring the non-conscious influence of food odors on children's food choices. The results highlighted a differential impact of non-attentively perceived

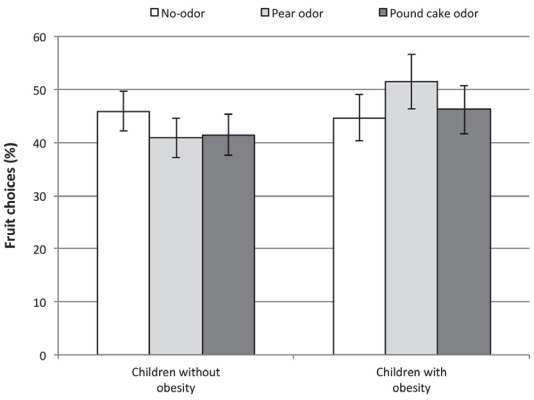


**FIGURE 1 | Percentage of fruit choices in the food choice intention task among normal weight ($n = 45$) and obese children ($n = 29$) in each olfactory condition (values are means ± SEM).**

**TABLE 3 | Effects of the olfactory condition on the nature of food choices: weight status-stratified analysis.**

| | Children without obesity ($n = 45$) | | Children with obesity ($n = 29$) | |
|---|---|---|---|---|
| | OR (95% CL)[a] | *P* | OR (95% CL)[a] | *P* |
| Pear odor vs. no-odor | 0.76 (0.64-0.90) | 0.0015 | 1.42 (1.13-1.78) | 0.0028 |
| Pound cake odor vs. no-odor | 0.79 (0.66-0.93) | 0.0062 | 1.07 (0.85-1.36) | 0.55 |

[a]*The nature of food choices was coded as 0 when a fatty-sweet food was chosen or as 1 when a fruit was chosen: the tested probability in these models is food choice = 1.*

odors depending both on the nature of the odors (fruity vs. fatty-sweet) and on children's weight status (with vs. without obesity). Whereas fruity and fatty-sweet odors increased the likelihood to choose fatty-sweet foods in normal-weight children, a fruity odor increased the likelihood to choose fruit in children with obesity. This pattern of results is different from our initial hypotheses but can be explained considering the differences in the mental representations of food between children according to their weight status.

Holland and colleagues have shown an enhanced accessibility to the concept of cleaning as a result of exposure to the odor of a typical cleaner, which influences the actual performance of cleaning behavior in adults (21). Based on this demonstration and on previous results regarding the effect of olfactory priming on food choice in adults (22–24), the hypothesis of this study was that a fruity or a fatty-sweet odor would enhance the accessibility of the fruit or fatty-sweet foods concept and would increase fruit or fatty-sweet food choice, respectively. Surprisingly, both a fruity and a fatty-sweet odor increased the likelihood to choose fatty-sweet foods in normal-weight children, whereas the same fruity odor increased the likelihood of choosing fruit in children who were obese. We suggest two possible interpretations for these results, as follows: (1) a sensory explanation: normal-weight children, unlike children with obesity, were not able to accurately differentiate the two food odors; and (2) a cognitive explanation: the fruity and the fatty-sweet odors activated the same mental representation in normal-weight children, leading to an increase in fatty-sweet food choices, whereas the fruity odor activated a different mental representation in children with obesity, leading to an increase in fruit choices.

Considering the first interpretation, the normal-weight children may not have been able to distinguish between the fruity and the fatty components of the two sweet odors. This hypothesis is unlikely given the research and care that was put into choosing the odors. Previous studies comparing olfactory sensitivity between normal-weight and obese subjects led to conflicting results. Some studies reported a decrease in olfactory sensitivity with increasing BMI in adults (28–30), whereas another study in children reported an increase in olfactory sensitivity with increasing BMI (31). Moreover, recent studies have shown that adults with obesity were better at detecting food odors than adults without obesity (32, 33). In summary, there is no strong evidence of a difference in the ability to properly identify food odors according to a subject's weight status, whether the subjects are adults or children.

The second interpretation is based on a previous study showing that children have distinct attitudes toward food based on their weight status (34, 35). While children without obesity primarily categorized food items according to affective criteria ("This food is yummy"/"This food is yucky"), children with obesity rather used cognitive criteria ("This food makes me strong"/"This food makes me fat"). Children without obesity have dominant pleasure-based attitudes toward food, and children with obesity have dominant nutritional-based attitudes. In a study involving adults, healthy eating prime words were subtly placed in the context of a "recipe flyer" handed out to shoppers when they entered a store, and its effect was assessed after the shopper had checked out by examining their cash register receipts for snack-item purchases (36). The authors reported less unhealthy snack food purchased when healthy eating primes were present but only for obese shoppers for whom the dieting goal was more important compared to non-obese shoppers. This demonstrates that behavioral priming effects depend on the relevance of the prime to the person's goals. Indeed, a recent meta-analysis showed that the behavioral priming effect was significantly stronger when the goal being primed was of personal importance to the participant (37). Thus, the same prime could enhance the accessibility of different concepts according to the internal representation retrieved by the prime and consequently have distinct effects on behavior. A food odor may enhance the accessibility of distinct mental representations associated with the food (e.g., pleasure, nutritional considerations, and dieting goals) according to individual characteristics, such as attitudes toward food. In the present study, it may be assumed that the fruity and fatty-sweet odors would have enhanced the accessibility of the food pleasure concept in children who were normal-weight, for whom it is the concept most closely associated with food in general (35). Consequently, it would have guided them toward more fatty-sweet food choices. Indeed, fatty-sweet foods are more commonly linked with palatability and food pleasure than fruit (e.g., palatable foods are associated with festive situations). On the contrary, a fruity odor would have enhanced the accessibility of nutritional considerations in children with

obesity due to the dominance of nutritional-based attitudes (34), resulting in more fruit choices, which can be considered as more frequent healthy food choices. The reasons why the fatty-sweet odor did not influence the food choices of the children with obesity need to be considered for future research. Indeed, the expected increase in fatty-sweet food choices when exposed to a fatty-sweet odor was not observed in children with obesity. Counteractive-control theory has been proposed to account for the activation of self-control processes in the face of temptation (38). In line with this theory, Coelho et al. have shown that food odor-exposed adults restrained eaters ate less than did non-exposed restrained eaters (39). Yet, restrained eating was measured in this study by using the restrained eating scale of the Dutch Eating Behavior Questionnaire for Children (40), and the results confirmed that the obese children were significantly more restrained than the other children (restrained eating score in obese children: $3.1 \pm 0.75$, in normal-weight children: $2.6 \pm 0.85$, $T$-test $P = 0.02$). Thus, more frequent healthy food choices in children with obesity when exposed to a palatable food odor could have also been expected. Therefore, the lack of a significant influence of the fatty-sweet food odor on children with obesity does not necessarily mean that they were not influenced by this odor, but it may reflect discrepant goals regarding palatable foods (achieving pleasure vs. achieving dieting goals).

Olfactory-congruent food choices (i.e., fruit choice with the fruity odor and fatty-sweet product choice with the fatty-sweet odor) may have been expected to be faster than olfactory-non-congruent food choices. However, in the task presented here, children were not asked to perform the task as quickly as possible, which led to a high variability in reaction times. A child could make a choice quickly or take time to consider the pros and cons for each pair of pictures. Reaction times are commonly used to reflect automatic and spontaneous activation (41) but might not constitute a relevant variable for a task that requires a deliberative decision, which may be the case here.

The food choice intention task measured hypothetical food choices with successive two-option forced-choice alternatives and no actual food choices were measured; this can be considered as a potential limitation. This questions the generalizability of our findings in a real food choice setting with more than two options. Nonetheless, a previous study in adults has shown that a non-attentively perceived fruity odor could influence food choices from a menu including 10 choices for each course category of a typical French meal (starter, main course, and dessert) (22). Moreover, regarding the comparison of hypothetical food choices and real food choices, the existing literature on adults suggests that food choice intentions would be good predictors of actual food choices (22, 24). It suggests that the findings of the present study should be replicable for real food choices in a situation including more than two food options. However, further research in real food choice setting – such as an appealing snack food buffet that would offer a range of sweet foods to the children for their after-school snack, for instance – is needed to confirm and extend our results.

Our findings raised some hypotheses that need to get addressed in future research to better understand the differences between obese and normal-weight children regarding their food odor reactivity. First; our results suggest that the accuracy in odor differentiation at low concentration levels might vary by children's weight status. It would be interesting to test this hypothesis in future research by developing a child-adapted methodology to compare food odor identification and discrimination as well as olfactory thresholds between obese and normal-weight children. The "Sniffin' Sticks" methodology developed by Hummel could be a child friendly way to asses such differences (42, 43). Second, we suggested that the different patterns of results obtained in both weight status groups of children might be due to differences in the mental representations activated by non-attentively perceived food odors. We hypothesized that the pear and the pound cake odors might activate the food pleasure concept in normal-weight children, whereas the pear odor might activate the nutrition concept in obese children. To test this hypothesis, the activated concepts by food odors have to be elucidated. Holland and colleagues showed that the presence of citrus scent enhanced the accessibility of the behavior concept of cleaning using a lexical-decision task (21). Participants were asked to indicate as quickly and accurately as possible whether a letter string appearing on a computer screen was an existing word, and participants in the scent condition responded faster to cleaning-related words than did participants in the control condition (21). Thus, one trail to test our hypothesis could be to ask children with and without obesity – as long as they can read – to perform a lexical-decision task using related words to the concepts of food pleasure vs. nutrition while they are exposed to the pear odor, the pound cake odor, or no-odor. Faster answers to food pleasure- or nutrition-related words in presence of a food odor would indicate the activation of the related concept by the odor.

In conclusion, a major difference was found between normal-weight children, for whom fruity and fatty-sweet food odors exposure resulted in more fatty-sweet food choices, and children with obesity, for whom fruity food odor exposure resulted in more frequent healthy food choices. Olfactory priming did not influence the children in the same manner, perhaps due to personal representations activated by the food odor, even if further research is needed to clarify this point. The priming paradigm allows us to access implicit mechanisms underlying food choice. These results help to better understand the implicit relationship between children's eating behavior and food cues in their environment based on weight status, avoiding the social desirability bias of explicit investigation methods. The primed concept, and the consecutive food choices, depends both on the nature of the prime itself and on the personal representation linked to the prime. Priming as an interventional tool in public health must be carefully controlled, with consideration of the personal goals of the children to avoid counter-productive effects.

## ETHICS STATEMENT

This study was carried out in accordance with the recommendations of the Comité pour la Protection des Personnes EST-1 Burgundy with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the Comité pour la Protection des Personnes EST-1 Burgundy, file number: 2015-A01547-42.

## AUTHOR CONTRIBUTIONS

LM designed the study, collected data, completed the statistical analysis, and drafted the manuscript. HB collected data. SC designed the study and contributed to the writing of the manuscript. All the authors helped interpret the findings, made a critical revision of the manuscript, read and approved the final manuscript.

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# CHAPITRE 6 :
# DISCUSSION GENERALE

Les travaux de recherche menés au cours de cette thèse ont permis d'explorer l'influence des considérations liées au plaisir ou à la santé sur les choix alimentaires des enfants normo-pondéraux et en surpoids. Nous avons notamment étudié le lien entre attitudes et choix alimentaires, et entre contextes de consommation et choix alimentaires. Des différences en termes de profil attitudinal orientés vers la santé ou vers le plaisir ont été mises en évidence en fonction du niveau scolaire, du statut pondéral et du milieu culturel des enfants. Nous avons montré que ces différences de profil attitudinal influençaient la qualité nutritionnelle des choix des enfants : un profil plus hédonique conduisait à des choix de meilleure qualité nutritionnelle. De plus, nous avons mis en évidence que des contextes de consommation mettant en valeur le plaisir ou la santé avaient une influence sur les choix alimentaires des enfants. En particulier, des contextes sociaux mobilisant des considérations liées à la santé ou au plaisir influençaient de la même manière les choix alimentaires des enfants normo-pondéraux et en surpoids. En revanche, des contextes olfactifs supposés activer des représentations liées à la santé ou au plaisir avaient une influence différente sur les choix alimentaires des enfants en fonction de leur statut pondéral.

Le présent chapitre a pour objectif de discuter ces résultats de manière transversale. Nous discuterons trois points : (1) l'interprétation et la pertinence des tâches d'association et de catégorisation construites dans le but de caractériser la dominance santé/plaisir des attitudes envers l'alimentation des enfants ; (2) la comparaison du rapport au plaisir et à la santé dans l'alimentation enfants normo-pondéraux et en surpoids ; (3) les implications de ce travail de thèse pour la promotion de comportements alimentaires favorables à la santé chez l'enfant (**Article 7**).

# 1. Mesurer la dominance santé/plaisir des attitudes envers l'alimentation chez l'enfant

## 1.1. Interprétation des tâches d'association et de catégorisation

### *1.1.1. La tâche d'association*

La tâche d'association a été développée pour évaluer, de manière indirecte, la dominance hédonique ou nutritionnelle des attitudes implicites des enfants envers l'alimentation. Au cours de cette tâche conduite sur un support informatique, l'enfant voit

apparaître à l'écran trois images d'aliments. Il lui est demandé de choisir les deux aliments qui « vont le mieux ensemble selon lui » parmi les trois (e.g., steak / poulet / frites). L'interprétation de cette tâche est basée sur le fait qu'une association du type steak-frites ou poulet-frites est censée refléter un rapport hédonique à l'alimentation tandis qu'une association du type steak-poulet est censée refléter un rapport nutritionnel. Sur la base des réponses des enfants est calculé un score hédonique d'association, c'est-à-dire le pourcentage d'associations hédoniques effectuées lors de la tâche. Néanmoins, on peut se demander dans quelle mesure associer deux aliments qui sont consommés ensemble reflète des considérations hédoniques envers l'alimentation appartenant à la composante affective des attitudes implicites, et inversement dans quelle mesure associer deux aliments qui appartiennent au même groupe d'aliments (au sens nutritionnel) reflète des considérations nutritionnelles envers l'alimentation appartenant à la composante cognitive des attitudes implicites.

Les *verbatims* des enfants, quant aux critères qui motivaient les associations qu'ils effectuaient, ont été recueillis auprès d'enfants français et américains dans le but de valider les triplets d'aliments inclus dans les tâches. L'analyse de ces *verbatims* permet de répondre en partie aux interrogations quant aux concepts mesurés par cette tâche. L'analyse thématique des *verbatims* (Braun & Clarke, 2006) a conduit à l'identification de cinq catégories de critères d'association partagées par les enfants français et américains :

1. Association culinaire / habitude : « ça va bien ensemble », « j'en mange souvent », « l'un se tartine, se mélange bien avec l'autre »
2. Appréciation / préférence : « j'aime ça avec ça », « c'est bon », « je préfère cette association aux autres possibles »
3. Choix par défaut : « je n'aime pas le troisième choix », « je n'ai jamais goûté le troisième choix »
4. Similitude : « c'est la même chose », « les deux se tartinent », « ce sont tous les deux … »
5. Nutrition : « les deux sont moins gras / sucré / mauvais pour la santé », « le troisième est plus gras /… »

Les critères des catégories 1, 2 et 3 étaient généralement utilisés pour justifier les associations codées comme « hédoniques » (e.g., steak-frites ou poulet-frites) tandis que les critères des catégories 4 et 5 étaient généralement utilisés pour justifier les associations codées comme « nutritionnelles » (e.g., steak- poulet).

Les catégories 2 et 3 regroupent des *verbatims* liés à l'appréciation sensorielle (positive ou négative) des aliments présentés et donc au plaisir ou au déplaisir de consommer ces aliments. Ces deux catégories sont donc cohérentes avec une interprétation hédonique des associations du type steak-frites ou steak-poulet. En revanche, le lien entre le plaisir et les *verbatims* de la catégorie 1 est plus discutable. En effet, la catégorie 1 regroupe des *verbatims* liés à des associations culinaires ancrées dans l'environnement alimentaire de l'enfant. Ces *verbatims* renvoient plus à des habitudes de consommation qu'au plaisir en tant que tel. Néanmoins, ces habitudes résultent des expositions répétées aux associations culinaires en question lors des repas. Une association est d'autant plus accessible en mémoire, et donc à même d'être effectuée spontanément lors de la tâche d'association, qu'elle est rencontrée fréquemment par les enfants. Or, en se basant sur des études réalisées chez l'enfant (Nicklaus, 2016), notamment concernant l'exposition répétée à un aliment donné (pour une revue de la litérature voir : Keller, 2014), on peut penser que l'exposition répétée à des associations d'aliments dans une culture donnée est à même de forger les catégories hédoniques des enfants. Ainsi, les *verbatims* renvoyant à une association culinaire pourraient être indirectement liés au plaisir de consommer ces aliments ensemble au sein d'un environnement culinaire dans lequel cette association est fréquente. Il semble néanmoins pertinent d'admettre que les associations dites « hédoniques » reflèteraient à la fois des considérations liées à l'appréciation des aliments par les enfants et à leur exposition aux associations culinaires à travers leurs expériences alimentaires antérieures.

La catégorie 5 regroupe des *verbatims* qui reflètent les connaissances des enfants quant à composition nutritionnelle des aliments ou quant à leur impact sur la santé. Les associations basées sur ces critères peuvent, sans ambiguïté, s'interpréter comme reflétant une prise en compte des informations liées à la nutrition lorsque les enfants rencontrent ces aliments. Par contraste, la catégorie 4 reflète des associations catégorielles de plusieurs sortes. Les aliments associés sont considérés comme semblables par les enfants : (1) pour des raisons nutritionnelles, steak et poulet sont deux sources de protéines ou (2) pour des raisons d'usage, steak et poulet sont interchangeables dans un repas. Les *verbatims* des catégories 4 et 5 regroupent donc des critères d'association basés sur la « fonction » des aliments, que ce soit en termes de nutrition ou d'usage. Les associations que l'on considère comme « nutritionnelles » refléteraient donc à la fois des considérations liées à la nutrition mais aussi à la place des aliments au sein d'un repas. Au sens large, il s'agirait donc d'associations basées sur la fonction des aliments, notamment nutritionnelle mais pas exclusivement.

Ces interprétations des associations, plus larges que les interprétations initiales développées dans cette thèse, éclairent les résultats obtenus lors des trois études conduites pour étudier les déterminants du profil attitudinal chez les enfants. Nous avons observé que la proportion d'associations hédoniques : (1) augmentait avec le niveau scolaire des enfants (**Article 1**), (2) était similaire chez les enfants normo-pondéraux et en surpoids (**Article 2**), et (3) était supérieure chez les enfants américains comparés aux enfants français (**Article 3**).

Il a été montré que dès l'âge de trois ans, les enfants sont capables d'utiliser à la fois des critères taxonomiques (e.g., fruits) ou des scripts (e.g., aliments qui se mangent au petit-déjeuner) pour associer les aliments entre eux (Nguyen & Murphy, 2003). Nous pouvons supposer que lorsque les enfants grandissent les deux types d'associations se renforcent : les associations d'ordre taxonomique par le biais de leur développement cognitif, et les associations liées aux scripts culinaires via les expositions répétées aux associations alimentaires dans leur culture. Lors de la tâche d'association que nous avons développée, les deux types d'associations étaient opposés (i.e., les enfants devaient choisir l'un ou l'autre). Les résultats de l'**Article 1** mettent en évidence que les associations liées aux scripts prédominent d'autant plus que les enfants grandissent.

Les résultats des études concernant la comparaison des enfants normo-pondéraux et en surpoids (**Article 2**) et des enfants français et américains (**Article 3**) laissent supposer que la dominance des scripts culinaires par rapport à des catégories fonctionnelles serait influencée plus par la culture que par des caractéristiques individuelles. Les aliments choisis pour développer la tâche d'association en France étaient consommés par plus de 95% des enfants dans chaque pays, laissant peu de place à des variations d'exposition entre les enfants. Qu'ils soient en surpoids ou normo-pondéraux, les enfants français ont grandi dans une même culture alimentaire et il est probable qu'un même niveau d'exposition aux aliments inclus dans la tâche d'association ait conduit à des proportions similaires d'associations basées sur des scripts culinaires culturellement partagés. En revanche, d'une culture à l'autre, nous avons observé des différences : les enfants américains associaient plus les aliments selon des scripts culinaires que les enfants français. Ces résultats reflètent des associations alimentaires plus ancrées culturellement aux Etats-Unis qu'en France. L'une des hypothèses que nous pouvons avancer pour expliquer cette différence est la plus faible diversité des régimes alimentaires aux Etats-Unis comparé à la France (Mathé, Francou, Colin, & Hébel, 2012). En effet, en 2007, il a été montré que les adultes français consommaient environ 17 produits différents sur deux jours contre moins de 14 aux États-Unis. Si, comme les adultes, les enfants américains

sont exposés à une moins grande diversité alimentaire que les enfants français, nous pouvons penser que les associations culinaires auxquelles ils sont exposés sont plus ancrées, mieux mémorisées et de fait plus spontanément mobilisables au cours de la tâche d'association.

Finalement, en s'appuyant sur l'analyse des *verbatims* des enfants ainsi que sur une lecture transversale des déterminants de la variabilité de la proportion d'associations dites « hédoniques » versus « nutritionnelles », un score d'association hédonique élevé pourrait refléter la prédominance d'appréhender l'alimentation selon des critères liés au plaisir alimentaires ou aux scripts culinaires au détriment de critères liés à leur fonction. On retrouve dans l'opposition de ces critères la dichotomie affective/cognitive des attitudes. En effet, effectuer des associations culinaires implique une projection dans l'acte alimentaire, une anticipation de ce que l'on va ressentir. Ces associations feraient donc bien appel à la base affective des attitudes. Au contraire, effectuer des associations basées sur la fonction d'un aliment ferait davantage appel à leur base cognitive. En résumé, la tâche d'association mesurerait bien une dominance affective/cognitive des attitudes implicites envers l'alimentation.

### *1.1.2. La tâche de catégorisation*

La tâche de catégorisation a été développée pour évaluer de manière directe la dominance hédonique ou nutritionnelle des attitudes explicites des enfants envers l'alimentation. Au cours de cette tâche, 51 images d'aliments apparaissent successivement à l'écran de la tablette tactile et il est demandé à l'enfant de les classer dans l'une des catégories suivantes : « ça donne des forces », « ça fait grossir », « c'est beurk », « c'est miam » ou « je ne connais pas cet aliment ». Pour interpréter les résultats de cette tâche, on considère que l'attitude explicite de l'enfant est d'autant plus hédonique que la proportion de catégorisations « c'est miam » ou « c'est beurk », faisant référence aux caractéristiques hédoniques des aliments, est élevée. Au contraire, on considère que l'attitude explicite de l'enfant est d'autant plus nutritionnelle que la proportion de catégorisations « ça donne des forces » / « ça fait grossir », faisant référence aux conséquences sur la santé des aliments, est élevée.

Comme décrit précédemment, les labels des différentes catégories ont été validés au cours de pré-tests menés avec des enfants du même âge n'ayant pas participé pas aux études. Les deux composantes, hédonique et nutritionnelle, étaient représentées par un label positif, respectivement « c'est miam » et « ça donne des forces », et un label négatif, respectivement

« c'est beurk » et « ça fait grossir ». De plus, les deux composantes reflètent une interaction entre le sujet et l'aliment : les effets positifs ou négatifs de la consommation d'un aliment soit sur le plaisir, soit sur la santé. Néanmoins, on souligne que le plaisir est un effet à court terme de la consommation alimentaire (et même concomitant), tandis que les effets sur la santé sont à plus long terme. Choisir une catégorie liée au plaisir versus liée à la santé implique donc un arbitrage de la part des enfants entre les effets immédiats ou différés de la consommation alimentaire. Dans cette perspective, il est envisageable que le degré d'impulsivité des enfants (i.e., la tendance à se projeter sur du court terme plutôt que sur du long terme) soit en partie capté par cette tâche.

### 1.2. Limites et pistes d'amélioration de l'outil MIAM

Concernant la tâche d'association, pour chaque triplet d'aliments deux associations affectives étaient possibles (e.g., steak-frites ou poulet-frites) mais une seule association cognitive (e.g., steak-poulet). Ce déséquilibre a pu entrainer une surestimation des associations affectives qui étaient deux fois plus probables au hasard qu'une association cognitive. Pour pallier ce biais méthodologique, une solution serait de proposer aux enfants un aliment cible (e.g., steak) et de leur demander de choisir entre deux autres aliments (e.g., poulet ou frites), celui qui va le mieux selon eux avec l'aliment cible. Ainsi, la probabilité d'effectuer une association affective (e.g., steak-poulet) serait identique à celle d'effectuer une association cognitive (e ;g., steak-frites).

Concernant l'outil MIAM dans sa globalité, les aliments présentés dans les deux tâches ont été sélectionnés sur la base de leur familiarité pour des enfants de 5 à 11 ans. Néanmoins, les aliments choisis n'étaient pas pour autant représentatifs du régime alimentaire des enfants de cet âge, ce qui questionne la généralisation de ces résultats ainsi que la robustesse de la comparaison interculturelle France / Etats-Unis. Il serait intéressant d'établir une méthodologie reproductible dans différentes cultures pour sélectionner les aliments à inclure dans les deux tâches. Par exemple, il serait envisageable de sélectionner un nombre d'aliments de chaque groupe alimentaire (e.g., fruits, légumes, produits laitiers, etc.) qui soit représentatif de leur fréquence de consommation relative dans la population d'enfants que l'on souhaite étudier. De plus, au sein de chaque groupe alimentaire, les aliments seraient sélectionnés sur la base de leur familiarité pour les enfants mais aussi sur la base de leur

typicité par rapport au groupe alimentaire (i.e., est-ce que l'aliment en question est bien reconnu comme appartenant à un groupe alimentaire donné par les enfants ?).

### 1.3. Pertinence du concept de profil attitudinal santé/plaisir

#### *1.3.1. Peut-on parler de dominance santé/plaisir des attitudes implicites et explicites envers l'alimentation ?*

L'objectif des tâches d'association et de catégorisation était de déterminer, respectivement de manière indirecte ou directe, la dominance des considérations liées au plaisir ou liées à la santé des attitudes implicites ou explicites des enfants envers leur alimentation. Les tâches d'association et de catégorisation semblent accéder à des construits distincts car les scores hédoniques implicites et explicites étaient indépendants dans les études conduites lors de ce travail de thèse : n = 194 ; r = -0,08 ; $P$ = 0,21 dans l'**Article 1**, n = 138 ; r = -0,02 ; $P$ = 0,86 dans l'**Article 2** ; n = 140 ; r = -0,16 ; $P$ = 0,06 dans l'**Article 3** et n = 63 ; r = 0.09 ; $P$ = 0,48 dans l'**Article 4**.

Dans nos travaux, les bases hédoniques et nutritionnelles des attitudes implicites et explicites envers l'alimentation étaient combinées en un seul score implicite ou explicite. Cela peut laisser supposer que plaisir et santé sont considérés comme les pôles opposés d'un même construit cognitif. Des études récentes ont évalué les corrélations entre les bases affectives et cognitives des attitudes dans le domaine alimentaire (Ayres, Conner, Prestwich, & Smith, 2012; Trendel & Werle, 2016). Concernant les attitudes explicites, Ayres et al. (2012) ont mis en évidence une corrélation non significative (n = 93 ; r = 0,08 ; $P$ > 0,10) entre l'appréciation déclarée pour le chocolat (« Je pense que pour moi manger du chocolat est : peu plaisant – plaisant / peu appréciable – appréciable ») et sa valeur santé perçue (« Je pense que pour moi manger du chocolat est : imprudent – sage / mauvais– bon pour la santé »). Concernant les attitudes implicites, Trendel & Werle (2016) ont mis en évidence une corrélation significative, mais qu'il qualifient de faible (n = 283 ; r = 0,19 ; $P$ < 0,001), entre les bases affectives et cognitives des attitudes implicites mesurées au moyen de deux tâches d'IAT. La corrélation absente ou faible entre les bases affectives et cognitives des attitudes suggèrent qu'elles sont indépendantes : on peut apprécier ou ne pas apprécier un aliment qu'on le considère comme bon ou mauvais pour la santé. Néanmoins, cela remet-il en question la mesure de la dominance relative des valeurs plaisir et santé ?

Selon le processus de prise de décision pour les choix alimentaires présenté au paragraphe 2.2. de l'introduction, lors d'un choix alimentaire plusieurs valeurs sont prises en compte et celles-ci peuvent avoir une origine affective ou cognitive (Rangel, 2013). Or, lorsque certaines valeurs entrent en conflit, les individus mettent en place des stratégies de priorisation basées en partie sur des motivations propres à chaque individu. Mesurer la dominance des bases affectives et cognitives des attitudes implicites et explicites ne remet donc pas en cause le fait que des considérations liées au plaisir ou à la santé soient deux construits distincts. Il s'agit d'une stratégie méthodologique dont le but est de prédire quel critère est le plus susceptible d'être utilisé lors d'un choix alimentaire.

D'ailleurs, Edwards & von Hippel (1995) avancent que l'attitude d'un individu envers un objet est généralement basée à la fois sur des considérations affectives et cognitives. Ils définissent la dominance affective ou cognitive comme la position d'un curseur d'un côté ou de l'autre d'un continuum dont les extrémités sont des hypothétiques attitudes purement affectives ou purement cognitives (Edwards & von Hippel, 1995). La dominance est donc le poids accordé aux bases affectives et cognitives, qui sont des construits distincts, dans la formation de l'attitude envers un objet qui pourra être plus ou moins positive ou négative.

Dans cette perspective, l'un des atouts des tâches d'association et de catégorisation telles que nous les avons mises en place, est qu'elles ne déterminent pas de manière dichotomique une dominance du plaisir par rapport à la santé ou inversement. Elles déterminent un score « continu » reflétant plus finement le poids relatif accordé au plaisir et à la santé dans la formation des attitudes implicites et explicites envers l'alimentation.

### *1.3.2. Peut-on prédire les choix alimentaires des enfants sur la base du profil attitudinal santé/plaisir ?*

Dans l'introduction de ce manuscrit, nous avons défini une attitude comme une association mémorielle entre un objet et son évaluation susceptible d'influencer le comportement d'un individu envers cet objet. En effet, selon si l'évaluation d'un objet est positive ou négative, un individu agira de manière favorable ou défavorable envers cet objet. De plus, les attitudes peuvent être basées sur des considérations affectives ou cognitives. C'est-à-dire qu'en fonction des individus, l'évaluation globale d'un objet découlera de critères affectifs (i.e., qui concernent les émotions, les ressentis) ou cognitifs (i.e., qui concernent les connaissances, les croyances). Mesurer la dominance des bases affectives et cognitives des

attitudes d'un individu vise à déterminer sur quels critères se construit préférentiellement l'évaluation globale d'un objet et donc la décision d'interagir ou non avec cet objet.

Ainsi, comme détaillé au paragraphe précédent, mesurer un profil attitudinal santé/plaisir envers l'alimentation chez l'enfant a donc pour but de caractériser dans quelle mesure l'attitude de l'enfant envers un aliment, et donc son interaction avec celui-ci, sera guidée par des considérations liées au plaisir ou à la santé. En s'inscrivant dans cette logique de réflexion, le plaisir de consommer un aliment aura d'autant plus de poids dans l'attitude envers cet aliment, et consécutivement dans le processus de choix alimentaire, que l'enfant présente une dominance attitudinale basée sur le plaisir. Inversement, la valeur santé d'un aliment aura d'autant plus de poids dans l'évaluation globale d'un aliment, et consécutivement dans le processus de choix alimentaire, que l'enfant présente une dominance attitudinale basée sur la santé. Ainsi, un profil attitudinal implicite ou explicite à dominance santé devrait forger une attitude implicite ou explicite positive envers les aliments perçus comme « bons pour la santé », et une attitude implicite ou explicite négative envers les aliments perçus comme « mauvais pour la santé », entraînant ainsi des choix globalement bons pour la santé chez les enfants présentant ce profil attitudinal. Or, les résultats décrits au **CHAPITRE 4** dans l'**Article 4** ne valident pas ces hypothèses. En effet, nous avons observé que les enfants présentant les profils attitudinaux implicites et explicites les plus basés sur la santé effectuaient les choix alimentaires les moins favorables à la santé.

Si ces observations sont en cohérence avec certaines études interculturelles chez l'adulte (Rozin et al., 1999; Saulais et al., 2012), ils apparaissent contre-intuitifs par rapport aux mécanismes de la relation attitude-comportement précédemment exposés. Le comportement est considéré comme la finalité de l'attitude, mais de nombreuses études n'ont mis en évidence que des corrélations faibles ou inexistantes entre les attitudes et les comportements (pour une revue de la litérature dans le domaine alimentaire, voir : Axelson, Federline, & Brinberg, 1985). Dans la littérature sur les attitudes, on trouve différentes explications à cette faible corrélation. Elles impliquent la mesure de l'attitude elle-même, les caractéristiques individuelles ou le contexte. Concernant l'influence de la mesure de l'attitude dans la cohérence de la relation attitude-comportement, Ajzen & Fishbein (1977) ont été les premiers à mettre en évidence ce qu'ils ont appelé le « principe de correspondance », c'est-à-dire qu'une attitude prédit d'autant plus un comportement qu'elle lui correspond précisément. Selon ce principe, si l'on veut prédire le fait qu'un individu consomme du chocolat aujourd'hui, il vaudra mieux l'interroger sur son attitude envers le fait de manger du chocolat

aujourd'hui que sur son attitude envers le chocolat en général. Plusieurs revues de la littérature assez anciennes ont confirmé que plus l'attitude mesurée est précisément reliée au comportement, plus elle est à même de le prédire (Davidson & Jaccard, 1979; Kraus, 1995). Néanmoins, on peut se poser la question de l'intérêt de mesurer des attitudes très précises dans le but de prédire un comportement. La démonstration de la relation attitude-comportement en deviendrait tautologique. Peu d'études se sont intéressées à l'influence de caractéristiques individuelles sur la cohérence de la relation attitude-comportement. Néanmoins, par exemple, il a été mis en évidence qu'un individu ayant une plus grande conscience de soi présentait une plus grande cohérence dans la relation attitude-comportement (Carver, 1975). De plus, de meilleures capacités d'auto-modération (i.e., la capacité à ajuster son comportement dans une situation sociale) seraient liées à une plus faible corrélation entre attitude et comportement (Zanna, Olson, & Fazio, 1980). Ce dernier résultat suggère qu'en fonction de certaines caractéristiques individuelles, la situation peut entraîner une déviation entre l'attitude et le comportement de l'individu. Ceci conduit la réflexion vers un troisième facteur pouvant influencer la relation attitude-comportement : le contexte.

Dans ce travail de thèse, nous avons envisagé séparément l'influence des attitudes et du contexte sur les choix alimentaires des enfants, sans étudier expérimentalement l'interaction entre attitudes et contexte dans le processus de prise de décision. Pour autant, comme l'indique notre schéma des liens potentiels entre profil attitudinal, contexte et choix alimentaire (**Figure 19**), nous avons bien à l'esprit qu'attitudes et contexte interagissent pour forger l'évaluation globale d'un aliment au moment du choix. Au paragraphe suivant, nous proposons de discuter les résultats décrits au **CHAPITRE 4** dans l'**Article 4** en envisageant les interactions entre attitudes et contexte au moment du choix.

### *1.3.3. Peut-on envisager une interaction entre profil attitudinal et contexte pour expliquer les choix alimentaires ?*

Certains modèles de prédictions des comportements offrent un cadre théorique intéressant pour penser l'influence conjointe des attitudes et du contexte sur les comportements alimentaires. C'est notamment le cas de la théorie de l'action raisonnée (Fishbein & Ajzen, 1975) et de son extension la théorie du comportement planifié (Ajzen, 1988) présentée **Figure 22**. Selon cette théorie, les individus sont susceptibles de choisir et de consommer un aliment donné : (1) s'ils croient que la consommation de cet aliment aura des

conséquences positives, (2) s'ils présument que les gens dont ils estiment l'opinion pensent que consommer cet aliment est une bonne chose, et (3) s'ils estiment que consommer cet aliment est facilement réalisable (e.g., pratique, dans leur budget, accessible). Une récente méta-analyse a mis en évidence la pertinence de ce modèle pour prédire les comportements alimentaires (McDermott et al., 2015).

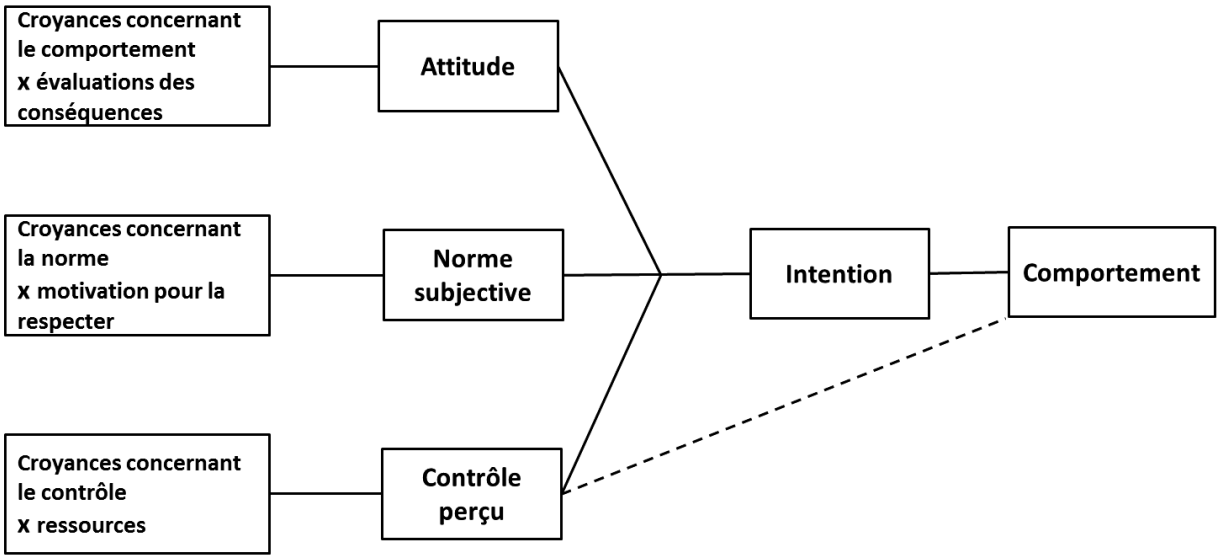


**Figure 22.** Représentation schématique des composantes de la théorie du comportement planifié. (D'après Ajzen, 1988) (----), influence possible

Selon Fazio (1990), la rencontre, dans une situation donnée, d'un objet générateur d'attitude active simultanément et automatiquement deux types de construits mémoriels : l'attitude, qui va influencer la perception par l'individu de cet objet dans cette situation précise, et les informations normatives, correspondant à la connaissance stockée en mémoire de ce que l'individu sait être le comportement socialement adapté à un contexte particulier, qui vont influencer la manière dont l'individu définit la situation. Ces deux construits mémoriels ont une influence sur l'interprétation de l'évènement (i.e., rencontre d'un objet particulier dans une situation précise) par l'individu puis sur son comportement (**Figure 23**).

Dans le cadre de l'étude présentée au **CHAPITRE 4** dans l'**Article 4**, qui visait à étudier le lien entre profil attitudinal et choix alimentaires chez les enfants, tous les participants étaient dans le même contexte de consommation mais présentaient des profils attitudinaux contrastés selon leur dominance santé/plaisir. Or, le buffet que l'on présentait aux enfants, constitué d'aliments très appréciés, a pu être perçu comme une situation de consommation particulièrement tentante et évoquant le plaisir. Dans ces circonstances, nous

avons observé que les enfants avec les profils attitudinaux les plus basés sur la santé effectuaient les choix alimentaires les moins favorables à la santé.

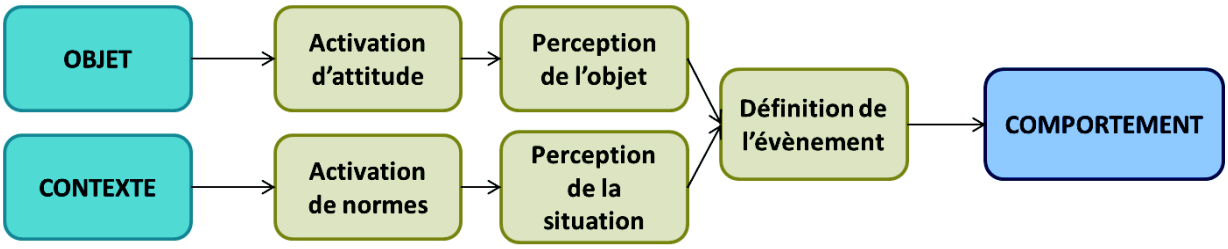


**Figure 23.** Interaction entre attitude et situation dans la prédiction d'un comportement. (D'après Fazio, 1990)

Afin d'expliquer ces résultats, nous faisons l'hypothèse *a posteriori* que ce contexte « plaisir » ait pu interagir avec les attitudes. En effet, les attitudes envers l'alimentation se forgent au travers des expériences alimentaires de l'enfant. Il est donc probable que les enfants dont les attitudes envers l'alimentation sont les plus basées sur la nutrition et la santé aient été exposés à un contexte familial mettant en avant les qualités nutritionnelles et les conséquences sur la santé de l'alimentation. On peut penser que ce type de contexte familial est lié à des pratiques parentales particulières, comme un accès limité aux aliments gras et sucrés par exemple. Or, il a été montré que l'interdiction de consommer certains aliments les rendait encore plus attractifs pour les enfants de 5 à 7 ans (Jansen, Mulkens, Emond, & Jansen, 2008; Jansen, Mulkens, & Jansen, 2007; Liem, Mars, & De Graaf, 2004). Chez les enfants dont les attitudes sont les plus basées sur des considérations liées à la nutrition et à la santé, le « plaisir » pourrait donc être incarné particulièrement par les aliments de moins bonne qualité nutritionnelle. De plus, les parents n'étant pas présents lors du choix de goûter, les enfants pouvaient se sentir soustraits à leur contrôle et donc autorisés à consommer ces aliments habituellement interdits (e.g., perception de la norme favorable au choix de tels aliments).

Cette interprétation des résultats implique qu'un même contexte puisse avoir une influence différente sur les choix alimentaires des enfants en fonction de leur profil attitudinal. Finalement, on peut supposer que lorsque l'attitude d'un enfant envers l'alimentation et le contexte de consommation sont congruents (e.g, valorisent la santé), attitude et comportement sont cohérents. En revanche, la relation attitude-comportement est plus difficile à prédire lorsque le contexte valorise une valeur qui n'est pas congruente avec les attitudes (e.g., un contexte plaisir et des attitudes à dominance santé). Dans l'étude

présentée au **CHAPITRE 4** dans l'**Article 4**, on peut penser que le plaisir mis en avant par le contexte a outrepassé les attitudes des enfants. Néanmoins, ce résultat n'est probablement pas généralisable à tous les contextes et à tous les individus. Par exemple, certaines caractéristiques individuelles, comme l'auto-modération évoquée précédemment, pourraient permettre de prédire si les attitudes ou le contexte prendraient le dessus dans la prise de décision alimentaire.

## 2. Comparaison des enfants normo-pondéraux et en surpoids

### 2.1. Appréciation des aliments par les enfants normo-pondéraux et en surpoids

D'une part, il est largement admis que l'appréciation des aliments est l'un des principaux facteurs influençant les choix alimentaires, que ce soit chez l'adulte (Glanz, Basil, Maibach, Goldberg, & Snyder, 1998) ou chez l'enfant (Birch, 1999; Pliner & Pelchat, 1986). D'ailleurs les résultats présentés au **CHAPITRE 5** dans l'**Article 5** confirment que l'appréciation des aliments prédit les choix des enfants aussi bien dans un contexte orienté plaisir que dans un contexte orienté santé. D'autre part, il a été démontré que le sucre et le gras présents dans notre alimentation contribuent à l'épidémie d'obésité (Lissner & Heitmann, 1995; Melanson, Astrup, & Donahoo, 2009; Van Baak & Astrup, 2009). Ainsi, il est communément supposé que des préférences pour le gras et le sucre, ou pour des aliments gras et sucrés, augmenteraient la consommation de ces macronutriments délétères pour la santé et contribueraient donc à l'apparition et/ou au maintien du surpoids et de l'obésité (Drewnowski, 1997).

Au cours de ce travail de thèse, nous avons interrogé des enfants normo-pondéraux et en surpoids quant à leur appréciation pour différents aliments à deux reprises, dans des conditions expérimentales différentes. Les résultats sont présentés dans les **Articles 2 et 5**. D'un point de vue méthodologique, dans les deux cas, les enfants devaient noter leur appréciation pour plusieurs aliments au moyen d'une échelle continue d'appréciation codée de 1 à 10 et illustrée par des smileys (i.e., « Combien aimes-tu cet aliment ? »). Dans le protocole présenté dans l'**Article 2**, les enfants notaient en autonomie sur tablette tactile leur appréciation des aliments, alors que dans celui présenté dans l'**Article 5** les enfants donnaient leur réponse au moyen d'une échelle sous forme d'objet lors d'une interview en face à face avec un expérimentateur. Les résultats présentés dans l'**Article 2** ont mis en évidence que les

enfants normo-pondéraux et en surpoids, âgés de 6 à 11 ans, notaient de manière similaire leur appréciation pour les fruits et légumes (n=19), les aliments gras, salés et sucrés (n=19), les viandes, œufs et poissons (n=6) et les fromages (n=4). Les résultats présentés dans l'**Article 5**, ont montré que les enfants en surpoids déclaraient apprécier autant les fruits (n=5) que les enfants normo-pondéraux. En revanche, ils déclaraient moins apprécier les aliments gras et sucrés (n=5) que les enfants normo-pondéraux. Cette différence concernant les résultats pour les aliments gras et sucrés est probablement imputable au mode de recueil des notes d'appréciation. En effet, il est probable que la présence d'un expérimentateur ait induit un biais de désirabilité sociale chez les enfants en surpoids. Leur perception de ce que l'« on attend d'eux » (i.e., manger moins d'aliments gras, sucrés, salés) et leur motivation à s'y conformer les auraient conduits à minimiser leur appréciation des aliments gras et sucrés face à un expérimentateur. Cette pression sociale était probablement moins saillante lorsqu'ils répondaient en autonomie avec la tablette tactile.

Nos résultats sont cohérents avec des études précédentes menées chez l'enfant (Hill et al., 2008) ou l'adolescent (Diehl, 1999) qui n'ont pas mis en évidence d'association entre le statut pondéral et l'appréciation pour les aliments gras et sucrés, dont la consommation pourrait être associée à l'adiposité chez l'enfant (Johnson, Mander, Jones, Emmett, & Jebb, 2008; Laura Johnson, Mander, Jones, Emmett, & Jebb, 2008), ou pour les fruits et les légumes, dont la consommation pourrait se substituer à celle d'aliment gras, sucrés et salés (Goldfield & Epstein, 2002). De plus, les nombreuses études qui ont tenté de mettre en évidence, chez l'adulte et chez l'enfant, un lien entre statut pondéral et appréciation pour le goût sucré et pour le goût du gras ont obtenu des résultats contrastés. Une récente revue de la littérature, concernant conjointement les études menées chez l'enfant et chez l'adulte sélectionnées sur la base de leur qualité méthodologique, a mis en évidence que sur 11 études étudiant le lien entre appréciation pour le goût sucré et statut pondéral, trois d'entre elles ont reporté une association positive, quatre une association négative, et les quatre autres une association non-significative (Cox, Hendrie, & Carty, 2016). Le lien entre appréciation pour le goût du gras et statut pondéral semble un peu plus robuste, bien qu'également controversé : sur 10 études, six ont reporté une association positive, une a reporté une association négative, et les trois dernières une association non-significative (Cox et al., 2016). En plus de ces résultats non consensuels quant à l'association entre appréciation du goût du sucre ou du gras et statut pondéral, le lien entre l'appréciation pour ces deux macronutriments et leur niveau de consommation n'est pas clairement établi (Cox et al., 2016). En particulier chez l'enfant,

plusieurs études impliquant des enfants de différentes tranches d'âge (4-5 ans, 6-9 ans et 7-12 ans) ont mis en évidence que l'appréciation du goût sucré n'était que faiblement, ou pas du tout, associée à la consommation à la consommation d'aliments sucrés (Divert et al., 2017; Lanfer et al., 2012; Olson & Gemmill, 1981). Concernant l'appréciation du gras, certaines études ont mis en évidence une association positive avec la consommation de gras chez l'enfant (Fisher & Birch, 1995; Ricketts, 1997) mais pas systématiquement (Lanfer et al., 2012).

Il semblerait donc qu'une appréciation élevée des aliments gras, sucrés, salés ou une appréciation faible des fruits et des légumes ne soit pas une explication satisfaisante de l'apparition et/ou du maintien du surpoids chez l'enfant. Ces résultats légitiment l'approche adoptée dans l'**Article 2**. En effet, nous nous sommes intéressés à un rapport plus global des enfants normo-pondéraux et en surpoids envers l'alimentation (i.e., leur dominance attitudinale). Cette approche nous a permis de mettre en évidence les différences attitudinales associées au statut pondéral chez les enfants et donc de mieux appréhender les spécificités des enfants en surpoids dans leur rapport à l'alimentation.

### 2.2. Connaissances nutritionnelles et attitudes concernant l'influence de l'alimentation sur la santé chez les enfants normo-pondéraux et en surpoids

Dans l'**Article 4**, il est décrit que les enfants en surpoids et normo-pondéraux ont noté leur perception de la valeur santé d'aliments (n=10) qui leur étaient présentés sous forme d'images. Nous n'avons pas mis en évidence de différence quant à la perception de la valeur santé de ces aliments entre les enfants normo-pondéraux et en surpoids. Quel que soit leur statut pondéral, les enfants étaient capables de différencier les aliments en fonction de leur qualité nutritionnelle : les aliments de moins bonne qualité nutritionnelle (i.e., de densité énergétique élevée : beignet, gâteau au chocolat, Smarties®, Kinder Bueno®, Ours d'Or®) étaient significativement perçus comme moins bons pour la santé que les aliments de bonne qualité nutritionnelle (i.e., de densité énergétique faible : pomme, banane, kiwi, compote de pomme sans sucres ajoutés, fraises). De plus, nous avons mis en évidence une corrélation négative significative entre densité énergétique des aliments et perception de leur valeur santé par les enfants : $\rho$ de Spearman = -0,68 ; $P$ = 0.03. Selon ces résultats, il semble donc que les enfants, indépendamment de leur statut pondéral, aient de bonnes connaissances concernant la qualité nutritionnelle des aliments.

Si les enfants normo-pondéraux et en surpoids partagent un niveau similaire de connaissances nutritionnelles, en revanche nous avons montré dans l'**Article 2** que la dominance relative des bases santé et plaisir de leur attitudes explicites différait. En effet, les enfants en surpoids ont des attitudes explicites plus basées sur des considérations liées aux conséquences sur la santé des aliments que les enfants normo-pondéraux. On peut penser que des connaissances nutritionnelles similaires n'impliquent pas pour autant que les enfants en surpoids et normo-pondéraux se sentent concernés de manière équivalente par des questions de santé en lien avec l'alimentation. D'après Nguyen et al. (2011), les connaissances nutritionnelles théoriques (i.e., savoir qu'un aliment est bon ou mauvais pour la santé) sont significativement corrélées avec les connaissances nutritionnelles pratiques (i.e., savoir qu'on doit manger tel ou tel aliment afin d'être en bonne santé) chez les enfants de 4 ans. Les auteurs avancent que les connaissances théoriques seraient un prérequis afin que les enfants sélectionnent des aliments qui participent à leur bonne santé. Néanmoins, en se basant sur les résultats présentés dans cette thèse et notamment dans les **Articles 4 et 5**, on peut supposer que les connaissances nutritionnelles pratiques ne peuvent se traduire en comportement de manière cohérente que si le contexte mobilise les considérations liées à la santé et à la nutrition.

### 2.3. Influence du contexte et statut pondéral : une relation complexe

Plusieurs études utilisant différentes méthodologies, déjà présentées au paragraphe 1.1.2. de l'introduction de ce manuscrit, ont montré que les enfants en surpoids étaient plus sensibles à leur environnement alimentaire que les enfants normo-pondéraux (i.e., vue, odeur, images d'aliments). Dans ce travail de thèse, nous avons étudié l'influence de contextes santé/plaisir sur les choix alimentaires des enfants normo-pondéraux et en surpoids. Pour cela nous avons manipulé soit des facteurs sociaux (**Article 5**), soit des facteurs physiques (**Article 6**) liés au contexte du choix alimentaire.

La manipulation des facteurs sociaux (**Article 5**) impliquait de demander aux enfants normo-pondéraux et en surpoids d'effectuer des choix d'aliments basés sur des images dans deux conditions sociales fictives : l'une orientée plaisir (i.e., un goûter d'anniversaire avec leurs amis), l'autre orientée santé (i.e., une intervention sur la nutrition dans leur classe). Dans les deux contextes sociaux, les enfants normo-pondéraux et en surpoids ont effectué des choix alimentaires de qualité nutritionnelle similaire : les choix alimentaires des enfants étaient de

meilleure qualité nutritionnelle dans le contexte social orienté santé comparé au contexte social orienté plaisir. Le fait que ces deux contextes sociaux aient eu la même influence sur les choix alimentaires des enfants normo-pondéraux et en surpoids suggèrent que ces deux groupes d'enfants partagent les mêmes normes sociales attachées à un goûter d'anniversaire et à une intervention sur la nutrition. Compte-tenu du fait que les enfants en surpoids ont des attitudes explicites davantage basées sur la santé que les enfants normo-pondéraux (**Article 2**), nous aurions pu nous attendre à ce que les enfants en surpoids utilisent plus le critère de la valeur santé des aliments au moment d'effectuer leurs choix alimentaires. Or, les résultats présentés dans l'**Article 5** ne montrent aucune interaction entre l'utilisation de critères plaisir ou santé pour effectuer les choix et le statut pondéral, ceci quel que soit le contexte social. Il semble donc que le contexte social prenne le pas sur les motivations individuelles sous-jacentes aux choix alimentaires des enfants. Ce résultat met en lumière les difficultés que peuvent rencontrer les enfants en surpoids pour s'astreindre à choisir des aliments qu'ils savent bons pour eux, notamment dans des contextes alimentaires sociaux qui exacerbent la valeur plaisir de l'alimentation.

La manipulation des facteurs physiques (**Article 6**) impliquait l'exposition des enfants à des odeurs alimentaires non-attentivement perçues (i.e., des amorces olfactives) : une odeur de fruit, la poire, et une odeur d'aliment gras et sucré, le quatre-quarts, pendant qu'ils exprimaient leurs intentions de choix alimentaires parmi des paires d'images d'aliments : un fruit versus un aliment gras et sucré. Les résultats ont montré une interaction entre le statut pondéral et l'amorce olfactive : chez les enfant normo-pondéraux les amorces olfactives « poire » et « quatre-quarts » augmentaient toutes deux la fréquence de choix d'un aliment gras et sucré comparé à une condition contrôle sans odeur, tandis que chez les enfants en surpoids l'amorce olfactive « poire » augmentait la fréquence de choix d'un fruit comparé à la condition contrôle. Nous émettons deux hypothèses alternatives pour expliquer ces résultats :

1. Les amorces n'activeraient pas les mêmes représentations chez les enfants normo-pondéraux et en surpoids. En effet, une amorce active la représentation qui lui est liée dans la mémoire de l'individu (Collins & Loftus, 1975) et donc potentiellement des représentations différentes chez chaque individu. Or, nous avons mis en évidence dans l'**Article 2** que les enfants normo-pondéraux envisageaient plus leur alimentation selon des considérations liées au plaisir, tandis que les enfants en surpoids l'envisageaient plus selon des considération liées à la nutrition et à la santé. Ainsi, nous faisons l'hypothèse suivante (**Figure 24**) : les

amorces olfactives « poire » et « quatre-quarts » activeraient le concept de « plaisir » chez les enfants normo-pondéraux induisant des choix plus fréquents d'aliments palatables (i.e., gras et sucrés) ; alors que l'amorce de poire activerait le concept de « nutrition, santé » chez les enfants en surpoids induisant des choix plus fréquents d'aliments bons pour la santé (i.e., des fruits).

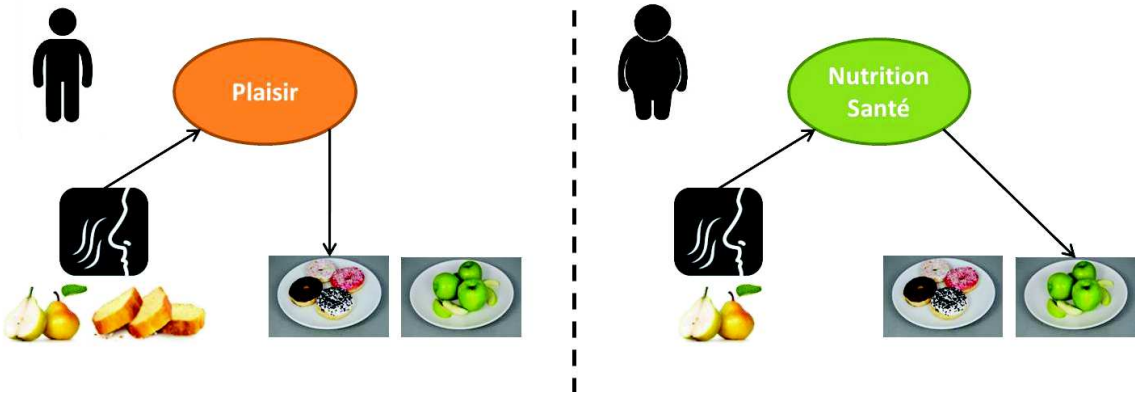


**Figure 24.** Illustration de l'hypothèse 1 pour expliquer les mécanismes sous-jacents de l'effet des amorces olfactives sur les choix alimentaires des enfants normo-pondéraux et en surpoids

2. L'hypothèse alternative (**Figure 25**) est que les amorces activeraient les mêmes représentations liées au plaisir alimentaire chez les enfants normo-pondéraux et en surpoids. Selon la « théorie du contrôle opposé » (Counteractive Control Theory, Trope & Fishbach, 2000), l'activation de ce concept de « plaisir » menaçant l'objectif de stabilisation ou de perte de poids des enfants en surpoids entrainerait en cascade l'activation de processus cognitifs liés au contrôle de leur prise alimentaire et consécutivement des choix plus fréquents d'aliments bons pour la santé (i.e., des fruits).

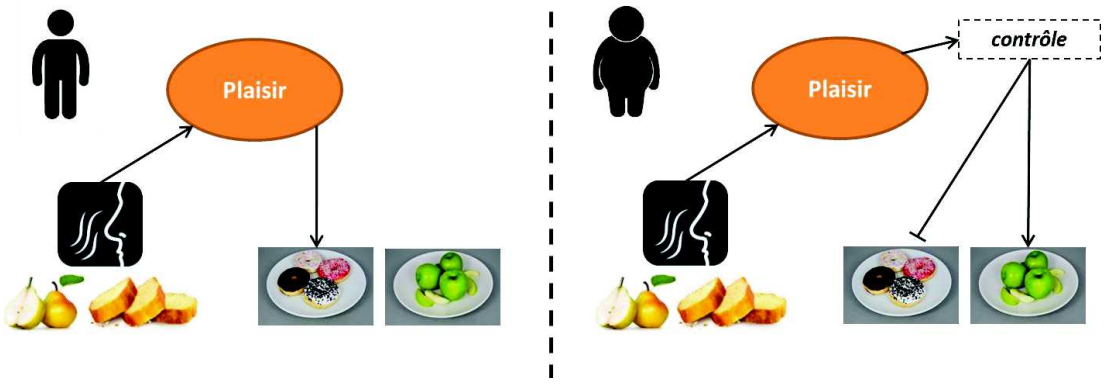


**Figure 25.** Illustration de l'hypothèse 2 pour expliquer les mécanismes sous-jacents de l'effet des amorces olfactives sur les choix alimentaires des enfants normo-pondéraux et en surpoids

Ces deux expérimentations, explorant l'influence de facteurs sociaux et physiques, conduisent à des conclusions différentes quant à l'effet du contexte alimentaire selon le statut pondéral de l'enfant. Si le contexte social a pris le dessus sur les différences interindividuelles potentielles dans la prise de décision entre les enfants normo-pondéraux et en surpoids, au contraire les amorces olfactives ont eu un effet différent chez ces deux groupes d'enfants dans l'orientation de leurs choix alimentaires. On souligne que ces deux expérimentations variaient aussi sur le fait que dans la première, une consigne *explicite* était donnée aux enfants pour effectuer leurs choix fictifs, alors qu'ils étaient exposés de manière *implicite* aux amorces olfactives, c'est-à-dire que les enfants n'étaient pas capables de reporter explicitement *a posteriori* la présence d'une odeur alimentaire pendant l'expérience. Finalement, on peut se demander si la nature des facteurs contextuels (i.e., sociaux *versus* physiques, explicites *versus* implicites) n'influencerait pas la manière dont les facteurs contextuels interagissent avec les motivations individuelles au moment d'un choix alimentaire.

## 3. Plaisir, santé et comportements alimentaires : implications pour la promotion d'une alimentation favorable à la santé chez l'enfant

Ce travail de thèse dans sa globalité a conduit à une réflexion autour de la place des valeurs plaisir et santé dans l'alimentation de l'enfant et de leur impact sur les comportements alimentaires. Au fil des lectures et de la mise en place des études décrites dans ce manuscrit, nous avons construit une conceptualisation originale du plaisir alimentaire. De cette conceptualisation est née l'hypothèse que le plaisir pourrait servir de levier pour l'adoption de comportements alimentaires favorables à la santé par les enfants.

Afin de faire valoir cette idée au sein de la communauté scientifique, nous avons écrit l'**Article 7**, une revue narrative qui met en évidence que le plaisir alimentaire pourrait accompagner et promouvoir une alimentation équilibrée chez l'enfant et donne des pistes pour de futures études visant à le démontrer.

# Article 7

**Learned pleasure from eating: an opportunity to promote healthy eating in children?**

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# Learned pleasure from eating: An opportunity to promote healthy eating in children?

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ABSTRACT

Across the lifespan, eating is a common everyday act driven by the search for pleasure and reinforced by experienced pleasure. Pleasure is an innate indicator of the satisfaction of physiological needs, in addition to other attributes. Pleasure from eating is also learned and contributes to the development of children's eating habits, which remain mostly stable until adulthood. Based on classical models of determinants of food consumption behaviour, we identified three dimensions of pleasure from eating learned during childhood: 1/the sensory dimension, i.e., pleasure from sensory sensations during food consumption; 2/the interpersonal dimension, i.e., pleasure from the social context of food consumption; and 3/the psychosocial dimension, i.e., pleasure from cognitive representations of food. The objective of this narrative review is to explore whether these three dimensions may play a role in promotion of healthy eating behaviour among children. Up to now, it was assumed that providing nutritional information, pointing out which types of foods are "good" or "bad" for health, would drive healthier food choices in children. Today, we know that such strategies based on a cognitive approach toward eating have a limited impact on healthy choices and can even be counter-productive, leading children to avoid healthy foods. In the context of increasing rates of childhood obesity, new perspectives are needed to build efficient interventions that might help children adopt a healthy diet. This review suggests new directions for further research to test the efficacy of novel interventions that emphasize pleasure from eating.



**Contents**



## 1. Introduction

Eating is one of the first needs of a child when he or she enters the world and is a primary source of pleasure. This innate pleasure

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from eating is closely linked with the satisfaction of physiological needs. New borns and infants particularly enjoy the sweet taste, which is a gustatory indicator of food energy density (Schwartz, Issanchou, & Nicklaus, 2009; Steiner, 1979). As an innate adaptive feature, newborns experience pleasure from energy-dense foods that guarantee their survival. In addition, infants are able to adjust their intake to the energy density of foods in such a way that they consume enough food to cover their needs, especially after having learned about the energy density of foods (Fomon, Filmer, Thomas, Anderson, & Nelson, 1975). However, as children grow, this self-regulation capacity progressively decreases (Fox et al., 2006; Kral et al., 2012; Remy, Issanchou, Chabanet, Boggio, & Nicklaus, 2015), while the sweet taste remains highly appreciated (Desor, Greene, & Maller, 1975; Schwartz et al., 2009; Zandstra & De Graaf, 1998), as are energy-dense foods (Drewnowski, 2009; Gibson & Wardle, 2003; Nicklaus, Boggio, & Issanchou, 2005). Knowing that the hedonic processes experienced while eating can override homeostatic satiety signalling, it is now known that the current overabundant food context may lead children to over-consume palatable and energy-dense foods (Dalton & Finlayson, 2013; Stroebe, Papies, & Aarts, 2008). Thus, pleasure from eating may in some instances be a threat to children's healthy eating behaviours. Because of the overabundance of palatable energy-dense foods, pleasure from eating is highly likely to lead to overeating and to overweight (Booth, Pinkston, & Carlos Poston, 2005). Consequently, children are often encouraged by parents, caregivers, and national campaigns to develop self-control abilities to resist pleasure and avoid tempting foods (Schlam, Wilson, Shoda, Mischel, & Ayduk, 2013). However, pleasure from eating is much more complex than the innate appeal towards foods that are high in fat and sugar and could even be protective of healthy eating behaviours, under certain conditions that will be described in this review.

Frijda describes pleasure as “a ‘niceness gloss’ attached to its object” (Frijda, 2009). This definition implies that pleasure emerges from the interaction between an individual and an object. Yet, the interaction with a food object results in eating it. According to this definition, we will consider *pleasure from eating* as the pleasantness experienced while eating which is a multifaceted phenomenon that derives from multiple complementary sources. Pleasure from eating is assumed to be a strong driver of consumption both in terms of food-choice decision-making and in terms of the amount of food consumed (Drewnowski, 1997; Yeomans, Blundell, & Leshem, 2004). Generally, models of determinants of food consumption behaviour distinguish between three types of determinants: 1/properties of the food, 2/environmental factors, and 3/factors related to the person engaged in food consumption (Steenkamp, 1993). We assumed that the influence of these three types of determinants on eating behaviour might be at some point mediated by pleasure deriving specifically from each of them (i.e., pleasure from sensory sensations, pleasure from the social context of food consumption, or pleasure from cognitive representations of food) and we explored these three dimensions of pleasure from eating with a multidisciplinary approach. Each dimension may contribute to shape pleasure from eating but the assessment of pleasure may vary across dimensions. In the literature, several methods have been developed to assess pleasure from eating in children: physiological measures such as functional magnetic resonance imaging (fMRI) (Burger & Stice, 2012; Stice, Spoor, & Bohon, 2008), declarative measures such as liking scales and food preferences (Chen, Resurreccion, & Paguio, 1996; Guinard, 2001), or behavioural measures such as recording facial expressions, acceptance and intake (Berridge, 2000; Madrelle et al., 2017; Schwartz et al., 2009). Each type of measure has pros and cons and should be interpreted cautiously in terms of pleasure. Indeed, fMRI is useful to evaluate the intensity of hedonic response associated to a food stimulus (Veldhuizen, Rudenga, & Small, 2010), but this particular context of food consumption is artificial and fails to integrate the social aspects of pleasure from eating. Using a liking scale, children are able to explicitly report pleasure deriving from a food (Birch, Zimmerman, & Hind, 1981; Hill, Wardle, & Cooke, 2009; Remy et al., 2014), but this measure does not take into account non-conscious pleasure mechanisms (Jacquier, Bonthoux, Baciu, & Ruffieux, 2012). Behavioural measures are indirect measures of pleasure from eating assuming that the behaviour observed is a consequence of pleasure from eating. If facial expressions and food acceptance are easily linkable to pleasure, intake is more controversial. In infants, as in animals, intake measurement for a particular food is classically considered as a liking indicator (Berridge, 1996). In later stages of life, the relationship between food choices or the amount of food consumed and the degree of pleasure elicited by this food is not so straightforward and may be modulated by individual attitudes toward food (Cantin & Dubé, 1999). Keeping in mind the limitations of each method, we did not exclude any experimental study from this review on the basis of the methodology used to assess pleasure from eating. The publications selected in this review aimed at illustrating the three dimensions of pleasure from eating previously described. We tried to specifically select experimental studies on children, but we also quoted experimental studies in adults and literature reviews notably to define theoretical concepts.

As young omnivores, children have to learn what, when, how, and how much to eat, in which context. In order to adapt to their culinary culture, children have behavioural predispositions that allow them to learn to like the foods made available to them (Nicklaus, 2015). In this perspective, pleasure may be an ally that helps children develop a healthy and culturally-adapted diet. Parents and caregivers play a major role in this learning process (for a review, see: Savage, Fisher, & Birch, 2007). Indeed, they participate in shaping children's food preferences by making some foods available rather than others (Cullen et al., 2003; Hearn et al., 1998; Kratt, Reynolds, & Shewchuk, 2000), and by acting as models of eating behaviours (Cullen et al., 2001; Young, Fors, & Hayes, 2004). Childhood is of particular interest for the study of eating behaviours because the early shaped preferences will remain stable until adulthood (for a review, see: Nicklaus & Remy, 2013). Moreover, the cultural context shapes attitudes towards food. For instance, it has been shown that pleasure and taste development are considered to be of primary importance at the age of complementary feeding by French mothers; in contrast, British mothers put an emphasis on health and nutrient qualities and not on the development of “palate” or “taste and flavour” (Caton, Ahern, & Hetherington, 2011; Schwartz et al., 2013). In adults, Rozin, Fischler, Imada, Sarubin, and Wrzesniewski (1999) observed that attitudes in France are more food pleasure-oriented and less food health-oriented than in the U.S.A., where foods are often viewed as a source of worry rather than of pleasure. Considering the lower prevalence of cardiovascular diseases in the French compared to American adults (Rosamond et al., 2008), as well as the lower prevalence of obesity in adults (Eschwège, Charles, & Basdevant, 2012; Flegal, Carroll, Ogden, & Curtin, 2010) and in children (Salanave, Castetbon, Péneau, Rolland-Cachera, & Hercberg, 2011; Skinner & Skelton, 2014), previous authors have emphasized that the importance of pleasure from eating and the minor role of health considerations could be protective in the context of healthy eating behaviours (Powell, Shima, Kazlauskaite, & Appelhans, 2010; Rozin, 2005; Rozin et al., 1999; Saulais, Doyon, Ruffieux, & Kaiser, 2010). In line with this hypothesis, the question addressed in this review is: can learning pleasure from eating promote healthier eating behaviours in children?

As mentioned above, we identified three dimensions involved in

building pleasure from eating during childhood: 1/the sensory dimension, i.e., pleasure from sensory sensations during food consumption; 2/the interpersonal dimension, i.e., pleasure from the social context of food consumption; and 3/the psychosocial dimension, i.e., pleasure from cognitive representations of food. In this narrative review, we describe the relationship between these three dimensions of pleasure from eating and food consumption. The objective is to explore, with a multidisciplinary approach, whether learning pleasure from eating during childhood might shape healthy eaters. First, the learning processes of deriving pleasure from eating in children will be described under these three complementary dimensions (sensory, interpersonal and psychosocial dimensions). Then, the potential lever opportunity of each dimension to encourage children's healthy eating behaviours will be discussed, including both how it can increase children's choices of healthy food options – *the qualitative issue* – and how it can limit children's consumption of energy-dense food – *the quantitative issue*. It was assumed that providing nutritional information, pointing out which types of foods are "good" or "bad" for health, would drive healthier food choices in children (Knai, Pomerleau, Lock, & McKee, 2006; Waters et al., 2011; Wolfenden et al., 2012). Yet, we know that such strategies based on a cognitive approach toward eating have a limited impact and can even be counter-productive, leading children to avoid healthy foods (Maimaran & Fishbach, 2014; Wardle & Huon, 2000). In the context of increasing rates of childhood obesity, this review presents new perspectives for building efficient interventions that might help children adopt a healthy diet. New directions for further research are suggested to test the efficacy of novel interventions that emphasize pleasure from eating according to these three dimensions.

## 2. The three dimensions of pleasure from eating during childhood

The aim of this section is to highlight that pleasure from eating can be learned during childhood through successive eating experiences and that it derives from several factors related to the food itself, the context of consumption, and the individual beliefs. Knowing that pleasure from eating is assumed to be a strong driver of food consumption (Drewnowski, 1997; Yeomans et al., 2004), understanding the mechanisms that shape pleasure from eating is of great interest to find insights regarding how to enhance healthy food consumption in children.

### 2.1. The sensory dimension: pleasure from food sensory properties

Pleasure derived from eating a food is linked with its perceptual characteristics (taste, flavour, and texture) in a complex and indirect way that depends on the food experience (Cabanac, 1979; Moskowitz, Kumaraiah, Sharma, Jacobs, & Sharma, 1975). Apart from the innate attraction to the sweet taste, sensory pleasure from food is learned in the first years of life through early eating experiences (Nicklaus, 2015). Very early in development, in fetal life, the physiological structures for taste perception are present (Ganchrow, Mennella, & Doty, 2003, pp. 823–846). Moreover, neonates are already able to detect odours (Engen & Lipsitt, 1965; Engen, Lipsitt, & Kaye, 1963; Russell, 1976). Oral-motor skills, which allow children to consume solid foods, are learned between 6 and 12 months; during this period, the tongue learns to move solid food around the mouth in preparation for swallowing, and this ability is dependent upon the experience of textured food (Gisel, 1990, pp. 69–79; Nicklaus, Demonteil, & Tournier, 2015). Thus, since the early stages of life, children are sensitive to food taste, flavour and texture, and the very first food exposures participate in learning pleasure from the sensory properties of foods.

Here, we give some examples to illustrate the learning process of deriving pleasure from the sensory properties of foods. It has been shown that a specific flavour exposure in utero increases the liking of this particular flavour later in life (Hepper, Wells, Dornan, & Lynch, 2013; Mennella, Jagnow, & Beauchamp, 2001; Schaal, Marlier, & Soussignan, 2000), and postnatal exposure to a flavour in the milk enhances the infants' acceptance of this flavour in solid foods (Mennella et al., 2001). Moreover, another study suggested that breastfeeding facilitated the acceptance of novel flavours, not necessarily in relation to exposure to specific flavour compounds (Hausner, Nicklaus, Issanchou, Mølgaard, & Møller, 2009). The authors hypothesized that breast-fed infants are possibly more familiar with a range of flavours than formula-fed infants, which might increase their acceptance of novel foods and flavours. Additionally, Sullivan and Birch (1994) found that at the beginning of the complementary feeding period, after 10 opportunities to consume a new vegetable, all infants significantly increased their intake. Other studies have similarly shown that infants' consumption and liking of a food increased through repeated exposures with slight variation across the food product (Barends, Vries, Mojet, & De Graaf, 2013; Keller, 2014; Maier, Chabanet, Schaal, Issanchou, & Leathwood, 2007; Mennella, Nicklaus, Jagolino, & Yourshaw, 2008; Remy, Issanchou, Chabanet, & Nicklaus, 2013). Regarding the texture of foods, current research puts forward that it might be easier to get infants to accept a wide range of textures if they are introduced to solid foods early within appropriate timeframes for introduction (for reviews, see: Harris & Coulthard, 2016; Nicklaus et al., 2015). These results suggest that early exposures enhance the ability to derive pleasure from foods. Moreover, this learning process is not limited to early life. An experiment in 2–5-year-old children showed that children increased their preference for high-density paired flavours after a conditioning phase (Johnson, McPhee, & Birch, 1991). Moreover, a recent study showed that repeated exposure to a novel flavour in sweetened beverages increased its liking in 8–11-year-old children (Remy et al., 2014).

Collectively, these studies highlighted that over successive eating experiences throughout childhood, children learn to like the sensory properties of the foods made available to them. Indeed, repeated exposure to a specific taste, flavour, texture or food enhanced the pleasure that derives from their consumption. Thus, children are able to learn pleasure from the sensory properties of foods even when the food is initially disliked (Maier et al., 2007). This strategy of repeated exposure might be used to establish healthy eating behaviour in children.

### 2.2. The interpersonal dimension: pleasure from interaction with others and sharing food

In France, the majority of 3–17-year-old children take their meals with family or friends: 68% at breakfast; 87% at lunch; and 96% at dinner (Bénetier et al., 2009). Social eating situations encourage interactions between people during meals and are crucial for the development of children's eating behaviours. Indeed, social learning plays a major role in guiding what and how much a child eats (for a review, see: Shutts, Kinzler, & DeJesus, 2012). A recent study demonstrated that young children learn which foods are palatable by observing other people eating (Liberman, Woodward, Sullivan, & Kinzler, 2016). In this study, 14-month-old infants watched movies in which actors interacted with two foods (food A and food B). First, an actor ate a bite from food A, liked the food, smiled, and said, "Ooh. I like that!" in a positive tone. Then, a second actor alternated between eating a bite from food A or food B, disliking it, frowning, and saying, "Ew. I don't like that" in a negative

tone. The results showed that the infants looked longer when the second actor disagreed with the first actor by disliking food A than when the second actor disliked food B. This demonstrates that the infants did not expect disagreement and that they generalized preferences across actors (Liberman et al., 2016).

Moreover, it has been shown that social eating impacts the amount consumed, acceptance of novel food, liking of food and food choices. For instance, infants (7–14 weeks) drink more formula when caregivers provide social interaction during feeding (Lumeng, Patil, & Blass, 2007), and young children (2.5–6.5 years) consume more pizza for a given snack duration when eating in a group of nine compared to three children (Lumeng & Hillman, 2007). In another study, adults presented unfamiliar foods to 14–20- and 42–48-month-old children individually in their homes (Harper & Sanders, 1975). The results showed that children were more likely to put the food in their mouth when the adults were also eating than when the adults were simply offering the food. Additionally, watching an adult eat an unfamiliar food can arouse a desire to eat this food in children (Addessi, Galloway, Visalberghi, & Birch, 2005; Harper & Sanders, 1975). Peer modelling also has a positive effect on novel food acceptance: children's novel food consumption increased after hearing a positive statement about the target food from their peers (Greenhalgh et al., 2009; Hendy, 2002). Studies have also shown that peers have more influence than adults on children's food selection (Frazier, Gelman, Kaciroti, Russell, & Lumeng, 2012; Hendy & Raudenbush, 2000). Thus, social modelling emerges for children as young as 1 year old (Harper & Sanders, 1975), and this phenomenon is stable across development (for a review, see: Cruwys, Bevelander, & Hermans, 2015). Additionally, Birch et al. (1981) demonstrated that foods presented in a positive social-affective context are significantly preferred by children than foods presented in a non-social context. In another study, Birch (1980) arranged consumption situations in which a target child who preferred vegetable A to B was seated with 3 or 4 peers with opposite preference patterns. In four occasions, children had to choose between vegetables A and B. The results indicated that the target children significantly increased their preference for the initially non-preferred vegetable. These results demonstrate that, in children, the learning process of deriving pleasure from eating is influenced by the social-affective context in which foods are presented, in particular by peer modelling.

When meals are shared with family or peers, children can model their eating behaviours but also talk about what they eat and share their sensations. Wiggins (2002) studied the expression of pleasure during mealtimes focusing on the "gustatory mmm" by using conversational data obtained from audiotaping the mealtimes of 10 families. Each family consisted of 2 parents and at least 1 child between the ages of 4 and 23 years. By the "gustatory mmm", the speaker refers to bodily sensations associated with pleasure. The author demonstrated by the analysis of mealtime conversations that the "gustatory mmm" is not only an expression of an internal, individual experience of pleasure, but it is inseparable from social, conversational and eating practices. Wiggins (2016) also investigated the role of language and gesture in parent-child interactions during mealtimes with younger children aged 5–8 months. Parents and their infants were recruited to video-record feeding interactions. How the facial expressions, vocalisations and bodily movements of parents are interpreted as evidence of a 'liked' or 'disliked' food by the children was analysed. The author concluded that pleasure from eating during childhood is in part constructed by interactions with others and is thus socially produced (Wiggins, 2002, 2016).

The studies presented in this section highlighted that children's eating behaviour is strongly influenced by the social context of food consumption. For infants and children, food pleasure seems to be not only associated with food products but also with social interactions during food consumption. Notably, since the age of 14 months, they learn pleasure from eating by observing other people eating (Liberman et al., 2016). Collectively, all of these studies provide experimental evidences that social eating, understood here as positive interactions between people during mealtimes, contributes to the learning process of pleasure from eating in children and might be used to intentionally increase pleasure from healthy food among children.

### 2.3. The psychosocial dimension: pleasure from cognitive representations of food

The act of eating is associated with cognitive processes such as thoughts, images and ideas that can modulate pleasure from eating. To describe the quality of a product, Nelson (1970) distinguished between the "search" qualities, which can be determined by the consumer prior to purchase – for instance, the presence of chocolate chips in a cookie – and "experience" qualities, which can only be ascertained after purchase – such as how crunchy the cookie is. Darby and Karni (1973) suggested a third category: "credence" qualities. Credence cannot be evaluated when using the product. In the case of a food product, it may involve labels or other types of information that cannot be properly assessed during consumption such as nutritional facts, production location, and ethics, among others. It has been suggested that credence cues, extrinsic to the food product (i.e., that are somehow related to the product but are not physically a part of it, such as a brand, label, packaging or any other form of marketing communications), form representations and expectations that influence experienced pleasure from a specific food (for reviews, see: Fernqvist & Ekelund, 2014; Piqueras-Fiszman & Spence, 2014). Thus, this dimension of pleasure from food is based on the hypothesis that hedonic reactions to a food stimulus result in part from one's representations about a food that create expectations on how pleasurable the food will be. Indeed, positive expectations can enhance actual liking through an assimilation effect: the perception of a food product tends to shift in the direction of prior expectations (e.g., Tuorila, Cardello, & Lesher, 1994). These expectations widely depend on one's attitudes, e.g., only health-conscious adults rate reduced-fat labelled products as more pleasant than the corresponding unlabelled products (Aaron, Mela, & Evans, 1994; Kähkönen, Tuorila, & Rita, 1996; Westcombe & Wardle, 1997). The influence of credence cues on children's eating behaviours has been widely studied in the field of food advertising and marketing (for a review, see: Story & French, 2004). Advertising is pervasive in children's environments, and marketing strategies commonly intend to modify children's representations using credence cues in order to create positive expectations about a food product (Strasburger, 2006). Here, we focus on the effect of credence cues on actual perceived pleasure from food, i.e., the influence of such cues on reported liking during consumption, whereas many marketing research studies have focused on children's food choices, which can have a direct influence on purchases. We provide examples from marketing and advertising studies.

The first question is whether children's eating behaviours can be influenced by credence cues. Indeed, such influence requires higher-level cognition, and from birth to adolescence, children sequentially develop cognitive abilities from a perceptual to a more abstract and analytical approach to their environment (cf. Piaget's theory of cognitive development). Studies in the field of marketing and advertising have shown that the nature of a child's comprehension of advertising significantly evolves according to the child's development stage (for a review, see: Roedder John, 1999). Prior to

the age of 7 or 8, children tend to view advertising as entertaining or informative, which makes them vulnerable and impacts their attitudes towards advertised foods. However, from 3 to 5 years, children have emerging brand representation abilities (McAlister & Cornwell, 2010). A child's first requests for a product may occur as early as 24 months of age, and foods that are the most requested first are breakfast cereals, snacks and beverages (McNeal, 1999). This could be partly due to the influence of food marketing. By the time children reach the age of 7–8 years, children begin to understand the persuasive intent of commercials (Blosser & Roberts, 1985; Robertson & Rossiter, 1974). Despite viewing advertising in a more analytical way, older children can still be persuaded by the emotive messages of advertising (Roedder John, 1999; Story & French, 2004).

Few studies have investigated the impact of brands on pleasure derived from eating in children. Sosa and Hough (2006) showed that brands have a positive effect on 10- to 12-year-old children's liking of cake, but only for children from medium-to high-income households compared to children from low-income households. Robinson, Borzekowski, Matheson, and Kraemer (2007) investigated the influence of brands on 3- to 5-year-old children's taste preferences for beverages. In this experiment, children tasted 5 pairs of identical foods and beverages in packaging from McDonald's and matched but unbranded packaging and were asked to indicate if they tasted the same or if one tasted better. The results indicated that children preferred the tastes of foods and drinks if they thought they were from McDonald's, all the more so as children had more television sets in their homes and had experience eating food from McDonald's more often (Robinson et al., 2007). Another study on adolescents (12–15 year olds) compared preferences for two different food product categories (chocolate breakfast cereal and seasoned cheese crackers) under three description conditions: blind (category only), context (flavour descriptor/category), and concept (branded). The results did not show any significant difference in preferences between the branded concept descriptor and flavour descriptor (Allison, Gualtieri, & Craig-Petsinger, 2004). Regarding food advertising, there is consistent evidence that it influences the preferences and diets of children (Cairns, Angus, Hastings, & Caraher, 2013; Hastings, McDermott, Angus, Stead, & Thomson, 2006; Hastings et al., 2003; McGinnis, Gootman, & Kraak, 2006). As TV advertising is the most popular promotional channel (Cairns et al., 2013), Jenkin et al. recently reviewed the persuasive techniques used to promote food to children on television (Jenkin, Madhvani, Signal, & Bowers, 2014). They showed that persuasive techniques are largely based on affective claims: premium offers (free gifts such as toys or cards; competitions; rebates; and vouchers), the use of promotional characters, and the theme of 'taste' and the emotional appeal of 'fun'. Despite the extensive literature dealing with the impact of advertising on children's eating behaviours, few studies have focused on the effect of advertising on pleasure derived from eating among children. Roberto, Baik, Harris, and Brownell (2010) studied the influence of licensed characters on the preferences of 4- to 6-year-old children and found that children significantly preferred the taste of foods that had popular cartoon characters on the packaging, compared with the same foods without characters.

We learnt from these studies that children early acquire expectations on how pleasurable a food will be based on extrinsic qualities, which may influence their experienced pleasure from eating the food. Indeed, since three years of age children have learnt to associate pleasure from a food with appealing communication (Roberto et al., 2010; Robinson et al., 2007; Sosa & Hough, 2006). Thus, such a communication strategy applied to healthy foods should be a good way to increase their attractiveness for children.

## 3. The three dimensions of pleasure as alternative levers for the adoption of healthy eating behaviours in children

### *3.1. Facing the dilemma considering nutrition versus pleasure: the contrasting effects of nutrition claims on children's eating behaviour*

From a public health perspective, many individual- or population-based interventions aimed to improve the nutritional quality of children's diets and to prevent obesity using cognitive information about the nutritional content of food or health consequences assume that nutritional knowledge will drive healthier food choices (for reviews, see: Knai et al., 2006; Waters et al., 2011; Wolfenden et al., 2012). For instance, since 2001 in France, the National Program on Nutrition and Health (Programme National Nutrition Santé), which aims at increasing fruit and vegetable consumption and reducing fat, salt and sugar consumption, provides nutritional messages such as "For your health, eat at least five fruits and vegetables per day" or "For your health, avoid salty, sweet and fatty foods" (Hercberg, Chat-Yung, & Chauliac, 2008).

In children, the promotion of healthy foods also involves provision of information about health benefits to convince them to eat. In line with the credence cues theory previously described, such provided information can influence pleasure from eating according to children's representations. Three studies investigated the effect of nutritional labels on food preferences in children. One study showed that 9–11-year-old children perceived cookies and crackers with a nutrition claim as healthier and as tastier than cookies and crackers without a nutrition claim (Soldavini, Crawford, & Ritchie, 2012). On the contrary, another study showed that 9–11-year-old children rated a new healthy labelled drink as less pleasant than the same new drink without a health label after tasting the two beverages (Wardle & Huon, 2000). Moreover, it has been shown that 4.5- to 5.5-year-old children rated crackers as less tasty and consumed fewer of them when the crackers were presented as instrumental to achieving a health goal (Maimaran & Fishbach, 2014). Despite such mixed results, these three studies suggest that children's representation of healthiness has an effect on pleasure derived from eating. The inconsistency in the results can be interpreted as differences in the used methodologies. For instance, the type of food product associated with a nutrition claim might influence the impact of the claim on preferences (Soldavini et al., 2012). Moreover, the observed differences may be due to attitudinal differences from one child to another regarding his or her concern about health consequences, which could generate different expectations. Engell, Bordi, Borja, Lambert, and Rolls (1998) observed that fat content information influenced cookie preferences in 10-year-old children who indicated a "high concern" for the health consequences of dietary fat, whereas cookie preferences were not affected by fat content labelling in subjects who indicated a "low concern". Likewise, McFarlane and Pliner (1997) showed that nutrition information increased willingness to taste a novel food among 10–13-year-old children for whom nutrition is important, and decreased willingness in children for whom nutrition is not important. These results suggest that children's attitudes may produce different expectations regarding the link between the "healthy" and "tasty" qualities of a given food. In a study of 9- to 10-year-old children, many children thought that 'if a food tastes good, it must not be good for me; and if a food tastes bad, it is probably good for me' (Baranowski et al., 1993). Thus, most of the children face the dilemma of considering nutrition and health versus pleasure, which can lead to the counter-productive effect of nutrition claims. Nonetheless, it is interesting to note that the link between healthiness and tastiness could be culturally built. Indeed, it has been shown that for American adults, unhealthy foods are implicitly associated with tastiness, whereas in France, unhealthy foods

are spontaneously associated with bad taste, while healthy foods are linked to tastiness (Raghunathan, Naylor, & Hoyer, 2006; Werle, Trendel, & Ardito, 2013).

Collectively, these data suggest that the promotion of healthiness in children has a contrasted impact on improving healthy eating behaviours. Further research is needed to better understand the psychological mechanisms underlying the effects of nutrition claims on children's pleasure derived from eating and on eating behaviours. It would be of particular interest to identify in which cases and for whom such nutrition claims are efficient or counterproductive. Notably, literature suggests that children aged from 2 to 7 years old can only focus on one aspect of a product at a time (Berman & Friedman, 1995; Guinard, 2001; Popper & Kroll, 2005) implying that if they focused on taste, they cannot process nutritional information. However, a recent study showed that children were able to classify food products taking into account healthiness and hedonic perception at the same time at the age of 5 years, 7 years and 9 years (Varela & Salvador, 2014). It could be interesting to investigate for each age group the effect of nutrition claims on actual food choices. Additionally, pointing out which types of foods are "good" or "bad" for health may lead children to believe that healthiness and tastiness are mutually exclusive characteristics (Baranowski et al., 1993); therefore, we suggest that nutritional policies could be more effective if they associated healthy foods with pleasure from eating.

### 3.2. Pleasure from eating, a lever to increase children's consumption of healthy food options – the qualitative issue

In a recent study, Nguyen, Girgis, and Robinson (2014) investigated the role of pleasure from food ("How yummy is this food?") versus health perception ("How healthy is this food?") on food selection ("Would you eat this food?") in 4- and 6-year-old children. They showed that hedonic rating is a more powerful determinant of food selection than perceived healthfulness. Pleasure from food is a strong determinant of food choices, which could be viewed as a threat regarding healthy eating behaviours considering early preferences for energy-dense foods (Drewnowski, 2009; Gibson & Wardle, 2003; Nicklaus et al., 2005). However, the innate appeal of children for energy-dense foods can be counterbalanced by learning to derive pleasure from healthy foods. This can be achieved by providing a varied and healthful diet from the first years of life. Indeed, familiarity plays an important role in the learning process of deriving pleasure from eating, and children's food preferences reflect the foods that are available and accessible to them (for a review, see: Nicklaus, 2015). Thus, repeated experiences with healthy foods can efficiently help children adopt a healthy diet using the learning process of deriving pleasure from eating as a lever.

The social context of food consumption influences children's eating behaviours (see above). Positive social contexts tend to increase children's consumption (Birch et al., 1981; Lumeng et al., 2007). Moreover, observing the food choices of others and their reactions in a social eating context influences children's own choices (Addessi et al., 2005; Birch, 1980; Harper & Sanders, 1975). Thus, sharing mealtimes – with family or peers – can provide children with the opportunity to observe their peers consuming healthy foods in a positive context. Such positive social contexts could help children to learn to like and eat healthy foods.

In the current context of ubiquitous marketing for unhealthy foods, the psychosocial dimension of pleasure from eating may be considered a threat to healthy eating behaviours in children. However, there are reasons to believe that this dimension could be easily used as a lever to encourage healthy eating behaviours in children. Resnicow et al. (1997) demonstrated that positive expectations, such as "If I eat fruits (vegetables) every day, my friend will like me more", were significantly associated with fruit and vegetable intake in 7–11-year-old children. In experimental studies, Wansink, Just, Payne, and Klinger (2012) demonstrated the efficacy of marketing-like strategies to improve the quality of children's food choices: attractive names increased the vegetable intake of 8–11-year-old children in elementary schools, and priming 6–12-year-old children with healthy food choices made by admired characters led them to make healthier food choices for themselves. These results suggest that pleasure from healthy foods can be learned by creating positive expectations and may improve the nutritional quality of children's diets (Jacquier et al., 2012; Thomas et al., 2003).

We highlighted that there are elements in the literature supporting the idea that the three dimensions of pleasure from eating previously described could constitute potential levers for encouraging healthy eating in children. However, further research is needed to investigate how all of these aspects of pleasure from eating could be combined in efficient interventions to increase the healthiness of children's diet. We provide some ideas of interventions that could be implemented and tested with children. The bottom line is: if we want children to learn pleasure from healthy foods, they need repeated experiences in positive social contexts with these foods, as well as opportunities to observe others enjoying healthy foods, and an environment that creates positive expectations towards them. A first intervention could target parents of new borns and aim at informing and accompanying them in elaborating strategies to make their children learn to derive pleasure from healthy foods, notably during complementary feeding which is known to be a critical period in the development of food preferences (Birch, 1999; Nicklaus, 2016). Parents should be provided with practical guidelines regarding how to manage repeated exposure with healthy foods, and how to create a positive food consumption context that enhances healthy food acceptance (e.g., social interactions, modelling). A second intervention, targeting children at school, could involve teachers and school-canteen staff in a program to promote pleasure from healthy foods based on the three dimensions highlighted in this review: 1/ school canteen meal plan should include a strategy of repeated exposure with healthy foods on the long run, 2/school canteen staff should act as role models by eating and enjoying healthy foods with children, 3/teachers should provide positive information about how pleasurable are healthy foods in order to create positive expectations towards those foods. Thirdly, an intervention in food stores could aim at making healthy foods more attractive to children using advertising and marketing methods (Evans, Christoffel, Necheles, & Becker, 2010). We believe that such strategies to improve the nutritional quality of children's diet based on levers deriving from pleasure from eating could be implemented in various contexts with the help of all the actors of child care: parents, caregivers, teachers, school canteens staff, medical doctors etc.

### 3.3. Pleasure from eating, a lever to limit children's consumption of energy-dense food – the quantitative issue

An abundance of literature showed that high palatability increases the intake of a particular food (Sørensen, Møller, Flint, Martens, & Raben, 2003; Yeomans, 1998; Yeomans et al., 2004). Paradoxically, in a recent study, Cornil and Chandon (2016) put forward that pleasure could be a substitute for large portion sizes. These authors set up a "multisensory imagery" intervention during which children were asked to imagine vividly the taste, smell and oro-haptic sensations of three palatable foods prior to choosing a portion size of another palatable food. The authors showed that

priming children's expectations about sensory pleasure led them to choose smaller portions of a palatable food. They suggested that this occurred because it prompted participants to evaluate portions based on expected sensory pleasure, which peaks at the first bites due to sensory-specific satiation (Cornil & Chandon, 2016). Indeed, sensory stimulations and associated hedonic responses diminish gradually during the consumption of a specific food. This phenomenon, called sensory-specific satiation, is well known in human adults (Rolls, 1986; Rolls, Rolls, Rowe, & Sweeney, 1981) and was also observed in children (Birch & Deysher, 1986; Olsen, Ritz, Hartvig, & Møller, 2011). Thus, focusing on sensory pleasure from food through "multisensory imagery" could decrease the amount of palatable unhealthy foods consumed by children. Enhancing sensory-based pleasure expectations can be an effective strategy for limiting children's consumption of energy-dense foods while preserving pleasure derived from these foods.

In a more ecological way, sharing meal times provides an opportunity to focus on pleasure derived from eating, notably by sharing thoughts about what is eaten. Fischler (2006) highlighted that commensal eating restores the conscience of what is eaten and consequently the pleasure from it. Yet, it is well known that overeating can be a consequence of "mindless eating", i.e., eating without being totally aware (Wansink, 2006). Sharing mealtimes, talking about what is eaten, and the associated pleasant sensations could increase the awareness of pleasure from eating and ecologically reproduce the intervention of Cornil and Chandon (2016). Thus, we assumed that commensality could help avoiding overeating in children by focusing their attention on the act of eating and the pleasure from it. For this to happen, adults have to guide children in this process and avoid distractions – such as TV programs. Further research is needed on this topic to properly demonstrate that pleasure from sharing mealtimes leads to a greater focus on what is eaten, thus preventing overeating among children. Interventions that aim at building commensal meal time – at home or at school – and encouraging children to focus on the sensory properties of foods should be implemented in order to test their impact on children's food consumption. For instance, parents and canteen staff should be asked to share meals with children, to put their sensations while eating into words and to incite children to do the same thing.

## 4. Conclusion

As highlighted in this review, pleasure from eating is a complex phenomenon that is partly learned across eating experiences during childhood. Three complementary dimensions of pleasure from eating were described: the sensory dimension, the interpersonal dimension and the psychosocial dimension, which interact with each other. The eating experiences during childhood, including what, when, how, and with whom, play a role in learning to derive pleasure from eating. The learning of deriving pleasure from eating is a process, which constitutes a major opportunity to shape healthy eating behaviours from early childhood. Indeed, children are able to learn to like and eat healthy foods by early, positive, and repeated experiences with those foods, as well as through opportunities to observe others consuming those foods. Further research is needed to support the idea that emphasizing deriving pleasure from eating could encourage children to adopt a balanced diet in the long run. Facing the contrasting, and sometimes counterproductive, effects of nutrition claims on children's eating behaviours, this review gives insights for new public health interventions. Future nutritional policies could be more effective if they aim to instil a positive association between healthy foods and deriving pleasure from eating in children.

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# CHAPITRE 7 : PERSPECTIVES

# 1. Perspectives quant à l'utilisation de l'outil MIAM permettant de mesurer les attitudes vis-à-vis de l'alimentation chez l'enfant

## 1.1. Envisager une validation externe de l'outil

L'outil MIAM présenté au **CHAPITRE 2** se compose d'une tâche d'association et de catégorisation. Il a pour but de caractériser la dominance relative des bases affectives et cognitives des attitudes explicites et implicites envers l'alimentation chez les enfants. Afin de confirmer nos hypothèses quant à l'interprétation des deux tâches de l'outil MIAM, il serait pertinent d'en envisager une validation externe en utilisant des tâches plus classiques pour mesurer les attitudes comme des questionnaires pour les attitudes explicites, et l'IAT pour les attitudes implicites (voir paragraphe 3.2.2. de l'introduction). En gardant à l'esprit notre objectif de caractériser la dominance des bases affectives ou cognitives des attitudes envers l'alimentation, l'idée serait de mesurer la contribution respective du cognitif et de l'affectif à l'évaluation globale des aliments. Ainsi, pour les attitudes implicites, un tel dispositif s'inspirerait du protocole de Trendel & Werle (2016) en développant des tâches de SC-IAT (i.e., IAT adapté pour mesurer les attitudes implicites envers un seul aliment) affectif, cognitif et évaluatif pour de nombreux aliments. Un modèle linéaire individuel, incluant le score du SC-IAT évaluatif comme variable dépendante et les scores des SC-IAT affectif et cognitif comme variables explicatives, permettrait d'évaluer pour chaque individu la contribution relative des bases affectives et cognitives aux attitudes implicites. On souligne néanmoins la lourdeur de ce protocole, impliquant trois SC-IAT à reproduire pour plusieurs aliments dans le but de modéliser individuellement la dominance des bases affectives et cognitives envers l'alimentation. Bien que méthodologiquement pertinent, ce protocole semble compliqué à mettre en place, notamment auprès d'enfants. De manière symétrique, pour les attitudes explicites, des échelles comportant des termes affectifs, cognitifs et évaluatifs pourraient être développées pour de nombreux aliments. De la même manière que pour les attitudes implicites, un modèle linéaire individuel permettrait d'évaluer la contribution des bases affectives et cognitives à l'attitude explicite envers les aliments pour chaque individu.

## 1.2. Nouvelles pistes de recherche avec l'outil MIAM

La tâche d'association, au cours de laquelle il est demandé aux enfants de choisir les deux aliments « qui vont le mieux ensemble selon eux » peut être déclinée à d'autres

domaines que celui de l'alimentation. Lors d'une étude interculturelle, Chiu (1972) a présenté des triplets d'images (e.g., une vache, une poule, de l'herbe) à des enfants chinois et américains et leur a demandé de choisir les deux images qui allaient le mieux ensemble en justifiant leur choix. Les résultats ont montré que les enfants américains effectuaient plus fréquemment des associations de type catégoriel (i.e., la vache va avec le poulet parce que ce sont tous les deux des animaux) alors que les enfants chinois effectuaient plus fréquemment des associations de type relationnel (i.e., la vache va avec l'herbe parce que la vache mange de l'herbe). Plus récemment, Ji et al. (2004) ont mis en évidence le même phénomène chez des étudiants chinois et américains en utilisant des mots au lieu d'images. Les auteurs expliquent ces résultats par l'interdépendance entre les individus encouragée par la culture chinoise, et au contraire l'indépendance encouragée par la culture américaine. Enfin, la même tâche a été proposée à une population exclusivement italienne (Knight & Nisbett, 2007). Les résultats ont mis en évidence que les Italiens du Nord, plus indépendants, effectuaient des plus d'associations catégorielles, alors que les Italiens du Sud, plus interdépendants, effectuaient plus d'associations relationnelles. De plus, les résultats mettent en évidence l'influence de la classe sociale sur le type d'associations effectuées, notamment chez les Italiens du Sud : les classes ouvrières raisonnent plus selon un mode relationnel, alors que les classes moyennes raisonnent plus selon un mode catégoriel. Ces résultats mettent en évidence qu'une tâche d'association peut être sensible à des facteurs culturels mais aussi à des facteurs plus proximaux tels que la classe sociale. Il serait intéressant de coupler notre tâche d'association propre au domaine alimentaire à une tâche d'association incluant d'autres objets. Cela permettrait de savoir si le type de raisonnement en lien avec l'alimentation, catégoriel (i.e., deux aliments semblables) ou relationnel (i.e., deux aliments qui se mangent ensemble), est corrélé au type de raisonnement de l'enfant en général ou s'il est propre au domaine alimentaire. De plus, il serait intéressant d'étudier si la classe sociale est un facteur susceptible d'influencer les réponses des enfants lors de la tâche d'association appliquée au domaine alimentaire.

## 2. Explorer le lien entre attitudes et comportements alimentaires

Dans le **CHAPITRE 4**, nous avons présenté une étude dont le but était d'étudier l'influence de la dominance plaisir versus santé des attitudes envers l'alimentation sur les choix alimentaires des enfants (**Article 4**). Néanmoins, comme discuté au paragraphe 1.2.3.

de la discussion générale, les profil attitudinaux que nous avons mesurés peuvent être associés à d'autres caractéristiques qui peuvent aussi expliquer les comportements alimentaires.

Pour étudier plus spécifiquement l'effet de la dominance du plaisir ou de la santé des attitudes sur les choix alimentaires des enfants, on pourrait imaginer de mettre en place un protocole permettant de manipuler les attitudes des enfants en rendant plus saillante la valeur santé ou la valeur plaisir attachée à l'alimentation. A la manière de Millar et Tesser (1986), qui ont imaginé un protocole permettant de focaliser les participants sur les bases affectives ou cognitives de leurs attitudes et d'étudier le lien avec les comportements (voir paragraphe 3.1.2. de l'introduction), une tâche pourrait être proposée aux enfants en amont de leur choix ; cette tâche aurait pour but d'exacerber les considérations liées au plaisir alimentaire ou à la santé. Par exemple, cela pourrait être réalisé en demandant aux enfants de classer des images d'aliments soit sur la base de leur appréciation, soit sur la base de leur valeur santé. Cette tâche serait présentée sous forme de jeu à la suite duquel les enfants participeraient à un goûter au cours duquel ils pourraient choisir plusieurs aliments (cf. méthodologie expérimentale de l'**Article 4**). Ainsi, nous pourrions observer si le fait d'avoir à l'esprit la valeur santé des aliments au moment du choix encourage des choix de meilleure qualité nutritionnelle chez les enfants.

## 3. Comprendre les mécanismes cognitifs sous-jacents à l'effet des odeurs non-attentivement perçues en fonction du statut pondéral chez l'enfant

Dans le **CHAPITRE 5**, nous présentons une étude dont l'objectif était d'évaluer l'effet d'odeurs non-attentivement perçues sur les intentions de choix d'aliments chez les enfants normo-pondéraux et en surpoids (**Article 6**). Comme discuté au paragraphe 2.3. de la discussion générale, les résultats questionnent les mécanismes cognitifs sous-jacents à l'effet des odeurs non-attentivement perçues sur les comportements de choix alimentaires. En effet, chez les enfants normo-pondéraux, les odeurs de poire et de quatre-quarts augmentaient la probabilité de choisir un aliment gras-sucré au détriment d'un fruit par rapport à une situation contrôle sans odeur. Chez les enfants en surpoids, seule l'odeur de poire avait un effet significatif par rapport à la situation contrôle et, à l'inverse, elle augmentait la probabilité de choisir un fruit. L'influence des odeurs est donc différente chez les enfants normo-pondéraux et en surpoids suggérant des mécanismes cognitifs différents. Outre l'hypothèse d'une différence de perception sensorielle des odeurs alimentaires entre les enfants normo-

pondéraux et en surpoids (voir **Article 6**), nous avons émis deux hypothèses cognitives pour expliquer ces résultats : (1) soit les amorces activent des représentations liées au plaisir chez les enfants normo-pondéraux, et liées à la nutrition chez les enfants en surpoids, (2) soit les amorces activent des représentations liées au plaisir dans les deux groupes d'enfants, mais ces représentations sont inhibées ou contrecarrées chez les enfants en surpoids car elles constituent une menace potentielle quant à leurs objectifs de stabilisation ou de perte de poids.

Afin de tester ces hypothèses cognitives nous avons imaginé d'évaluer l'effet des amorces olfactives poire et quatre-quarts sur l'activation des représentations liées au plaisir ou à la santé chez des enfants normo-pondéraux et en surpoids. Ce travail de recherche, qui constituait une perspective de mon travail de thèse, a été mené dans l'équipe au cours du premier semestre 2017 par Catherine Juneau, étudiante en Master 2 de Psychologie encadrée par Stéphanie Chambaron et moi-même. Nous présentons ici brièvement la méthodologie mise en place pour ce travail, ainsi que les principaux résultats.

Cette nouvelle phase expérimentale a été conduite avec 39 enfants, dont 17 en surpoids et 22 normo-pondéraux. Le protocole d'amorçage olfactif était strictement identique à celui présenté dans l'**Article 6**. En revanche, la tâche d'intention de choix était remplacée par une tâche de Stroop émotionnelle permettant de mesurer les biais attentionnels.

La tâche de Stroop émotionnelle est un paradigme expérimental modifié à partir de la tâche de Stroop originale (Stroop, 1935) au cours de laquelle sont présentés aux participants des noms de couleur (e.g., « rouge », « vert ») écrits en diverses couleurs. Les participants doivent dénommer le plus rapidement possible la couleur des mots qui leur sont présentés. On constate un ralentissement du temps de réponse quand le nom de couleur et la couleur du mot ne sont pas congruents (e.g., « rouge » écrit en vert). Cet effet traduit une interférence entre le processus automatique de lecture du mot et l'action demandée, c'est-à-dire dénommer la couleur du mot. Dans la tâche de Stroop émotionnelle, des mots de valence émotionnelle et des mots neutres sont présentés aux participants écrits en couleur. On mesure la différence entre le temps mis pour dénommer la couleur des mots émotionnels et le temps mis pour dénommer la couleur des mots neutres. Un ralentissement pour dénommer la couleur des mots émotionnels par rapport aux mots neutres traduit alors un biais attentionnel, c'est-à-dire une attention accrue pour le contenue sémantique de ces mots comparativement aux mots neutres. La tâche de Stroop émotionnelle a déjà été utilisée chez l'enfant, et particulièrement dans le domaine alimentaire pour comparer l'effet d'interférence pour des noms d'aliments (e.g.,

chantilly, pizza) chez des enfants normo-pondéraux et en surpoids (Braet & Crombez, 2003b). Les résultats de cette étude ont montré que les enfants en surpoids étaient plus lents que les enfants normo-pondéraux à dénommer la couleur des noms d'aliments par rapport à des mots contrôle (e.g., facteur, radiateur). Les auteurs concluent à un biais dans le processus du traitement de l'information chez les enfants en surpoids lorsqu'ils sont exposés à des noms d'aliments ce qui traduirait une sensibilité accrue à leur environnement alimentaire.

Dans notre étude, nous avons développé une tâche de Stroop émotionnelle en utilisant des mots liés au plaisir (i.e., appétissant, gourmand, bon, miam, délicieux) et des mots liés à la santé (i.e., régime, maigrir, poids, grossir, kilo) appariés à des mots neutres (i.e., rugissement, panthère, zoo, loup, mammifère, canapé, torchon, tapis, chiffon, drap). Nous supposions qu'un temps plus long pour dénommer la couleur des mots « plaisir » par rapport aux mots neutres traduirait une plus grande attention accordée au plaisir alimentaire. De même, un temps plus long pour dénommer la couleur des mots « santé » par rapport aux mots neutres traduirait une plus grande attention accordée à la valeur santé. La tâche de Stroop était répétée dans les trois contextes olfactifs : poire, quatre-quarts et sans odeur, de manière identique à l'exposition non-attentive présentée dans l'**Article 6**. Chez les enfants normo-pondéraux, nous faisions l'hypothèse que dans les conditions olfactives « poire » et « quatre-quarts » nous observerions un temps plus long pour dénommer la couleur des mots « plaisir » par rapport aux mots neutres, révélant une activation du concept de « plaisir ». Chez les enfants en surpoids, nous faisions deux hypothèses : (1) un temps plus long pour dénommer la couleur des mots « plaisir » par rapport aux mots neutres, révélant une activation du concept de « plaisir » dans les deux conditions olfactives et (2) un temps plus long pour dénommer la couleur des mots « santé » par rapport aux mots neutres, révélant une activation du concept de « santé » dans la condition olfactive « poire ».

Nous n'avons pas mis en évidence le ralentissement attendu pour dénommer la couleur des mots cibles – comparativement aux mots neutres – dans les deux conditions olfactives, ni chez les enfants normo-pondéraux ni chez les enfants en surpoids. En revanche, nous avons observé un phénomène de facilitation dans le traitement des mots « plaisir » par rapport aux mots neutres, spécifiquement chez les enfants normo-pondéraux lors de l'exposition aux odeurs de poire et de quatre-quarts. En effet, les enfants normo-pondéraux étaient plus rapides pour dénommer la couleur des mots « plaisir » comparativement aux mots neutres dans les deux conditions olfactives, alors que leur temps de réponse pour les mots « plaisir » ou neutres était identiques dans la condition sans odeur. Aucune différence n'a été observée entre

le temps de traitement des mots « santé » et des mots neutres quelle que soit la condition olfactive, ni chez les enfants normo-pondéraux ni chez les enfants en surpoids.

Le phénomène de facilitation observé chez les enfants normo-pondéraux pour les mots « plaisir » traduit un traitement cognitif plus rapide de l'information. Il a été montré, chez l'adulte, que l'exposition non-attentive à une odeur améliore les performances lors d'une tâche de décision lexicale spécifiquement sur pour les mots cibles liés à l'odeur (Coelho, Polivy, Herman, & Pliner, 2009; Gaillet, Sulmont-Rossé, Issanchou, Chabanet, & Chambaron, 2013; Holland, Hendriks, & Aarts, 2005). Selon les auteurs, ce phénomène traduit l'activation non-consciente d'un concept qui faciliterait le traitement des informations qui lui sont liées. De la même manière, la facilitation que l'on observe chez les enfants normo-pondéraux pourrait résulter de l'activation du concept de « plaisir » par les odeurs alimentaires. La lecture des mots en lien avec le concept de « plaisir » serait accélérée par cette activation et le temps mis pour en dénommer la couleur serait diminué. On souligne que ce phénomène de facilitation n'est pas observé chez les enfants en surpoids.

Nous n'avons pas mis en évidence l'activation de représentations liées à la « santé » par l'odeur de poire chez les enfants en surpoids. Néanmoins, les mots choisis pour représenter le concept de « santé » étaient plus axés sur le contrôle du poids que sur la nutrition, cela constitue une limite de cette étude. Nous n'avons pas non plus mis en évidence une activation similaire du concept de « plaisir » chez tous les enfants quel que soit leur statut pondéral. Il semblerait que l'activation du concept de « plaisir » n'ait lieu que chez les enfants normo-pondéraux. Pour aller plus loin et avancer dans notre compréhension des mécanismes cognitifs en jeu dans les effets comportementaux de l'amorçage olfactif chez l'enfant normo-pondéral et en surpoids, nous pourrions soit répliquer cette étude en utilisant d'autres registres de mots liés au plaisir et à la santé, soit utiliser une autre tâche, par exemple une tâche de décision lexicale déjà utilisée dans le cadre d'un paradigme d'amorçage dans le domaine alimentaire chez l'adulte (Gaillet et al., 2013).

## 4. Le plaisir : un levier pour l'adoption de comportements alimentaires favorables à la santé de l'enfant ?

Ce travail de thèse a conduit à une réflexion globale sur la place du plaisir alimentaire dans l'alimentation de l'enfant. Comme présenté dans la revue narrative (**Article 7**), nous

nous sommes notamment questionnés sur le rôle que pouvait jouer le plaisir alimentaire dans l'adoption de comportements alimentaires favorables à la santé par les enfants – à la fois d'un point de vue qualitatif et quantitatif.

Dans cette perspective, l'**Article 7** propose plusieurs types d'interventions (à la maison, à la cantine, dans les supermarchés) qui permettraient de tester l'efficacité de stratégies basées sur le plaisir pour améliorer la qualité nutritionnelle du régime alimentaire des enfants. Le but n'est pas ici de répéter ce qui a été présenté dans cet article, mais de souligner que la mise en place et l'évaluation des interventions qui y sont présentées constituent une perspective majeure de ce travail de thèse en termes de santé publique.

# CONCLUSION

Ce travail de thèse proposait d'explorer l'influence des considérations liées au plaisir ou à la santé sur les choix alimentaires chez les enfants normo-pondéraux et en surpoids. Les études menées ont permis de revenir sur certaines idées reçues, soulignant tout l'intérêt d'avoir exploré cette question. En effet, nous avons mis en évidence que si l'appréciation des aliments était un critère important dans les choix alimentaires des enfants, cela n'était pas incompatible avec le choix d'aliments favorables à la santé pour la majorité d'entre eux. D'ailleurs, les enfants pour qui le plaisir est la valeur dominante font les meilleurs choix en termes de qualité nutritionnelle ! Ces résultats nous ont permis d'amorcer une réflexion quant à la place centrale que pourrait jouer le plaisir dans la promotion de comportements alimentaires favorables à la santé chez les enfants normo-pondéraux ou en surpoids. Nous ne nions pas que, dans certains contextes, valoriser la santé peut conduire à des choix plus favorables à la santé par les enfants. Nous l'avons d'ailleurs démontré dans l'une de nos études. Néanmoins, compte tenu du fait que l'appréciation des aliments reste un critère de choix même dans ce type de contexte, nous attachons une importance particulière à la valorisation des aliments « bons pour la santé » en termes de plaisir.

Le plaisir de manger s'acquiert au travers des expériences alimentaires, tout au long de l'enfance et même tout au long de la vie. Les enfants sont capables d'apprendre à aimer tous les aliments, à condition qu'ils leur soient proposés régulièrement et dans un contexte positif. De plus, cet apprentissage du goût, ancré dans la culture alimentaire française (Schwartz et al., 2013), favorise l'attention portée aux aliments qui sont consommés et le partage à travers la verbalisation de ses propres sensations. A l'opposé du « *mindless eating* », l'apprentissage du plaisir alimentaire rime plus avec qualité qu'avec quantité et favorise ainsi une forme de modération. De cette réflexion sont nées des perspectives concrètes dans la société civile, notamment pour la prise en charge du surpoids et de l'obésité chez l'enfant.

En parallèle de ce travail de thèse, nous avons construit un programme d'éducation thérapeutique du patient (ETP) en collaboration avec des collègues du CHU de Dijon (endocrino-pédiatre, diététiciennes, psychologues). L'objectif d'un programme d'éducation thérapeutique est de permettre au patient d'acquérir les compétences qui lui permettent de devenir acteur de la prise en charge de sa pathologie au quotidien. Le programme que nous avons construit, actuellement à l'état de pilote, a été proposé à l'Agence Régionale de Santé

de Bourgogne-Franche-Comté pour validation. Il est constitué de 6 séances de 2h et destiné aux enfants et adolescents en surpoids et à leurs parents. Il inclut en particulier des ateliers autour du plaisir alimentaire au cours desquels nous explorons avec les patients les qualités sensorielles des aliments au travers de dégustations. En lien avec les dégustations, nous travaillons aussi sur l'attention portée à l'aliment et à soi. Nous abordons également l'importance du contexte de consommation, de la commensalité et du partage. *In fine*, l'objectif de ces ateliers est de faire prendre conscience aux enfants et à leurs parents que la perte de poids n'est pas forcément associée à la privation et à la diminution du plaisir alimentaire.

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