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# Unpacking noun-noun compounds: Interpreting novel and conventional food names in isolation and on food labels

**Abstract:** In two complementary experiments we took an integrated approach to a set of tightly interwoven, yet rarely combined questions concerning the spontaneous interpretation of novel (unfamiliar) noun-noun compounds (NNCs) when encountered in isolation, and possible (re)interpretations of novel as well as conventional (familiar) NNCs when encountered in verbo-visual context. To enhance ecological validity, we mirrored our research questions in real-life concerns on the naming of commercial food products and the risk of consumers being misled by the names that producers give to them, focusing on the Danish food market and using Danish NNCs. Specifically, we addressed a highly productive type of compound food names where the modifier denotes a geographical entity and the head denotes a type of food, e.g. Hawaii pizza. Our findings contribute new evidence to central issues of (cognitive) linguistic theory concerning the relations between semantics and pragmatics, as well as system and usage, and psycholinguistic issues concerning the processing of NNCs. New insights and methodological tools are also provided for supporting future best practices in the field of food naming and labelling.

**Keywords:** noun-noun compounds, semantics, pragmatics, lexicalization, compound word processing, context, verbo-visual communication, visual attention, food labelling, consumer law

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# 1 Introduction

## 1.1 Theoretical background: The meaning of noun-noun compounds

In Germanic languages such as English, Danish, and German, a widespread way of introducing new entries into the lexicon is to join together two pre-existing nouns to form a *noun-noun compound* (NNC), e.g. *mouse mat* and *snow smoothie*. Despite their commonness, the meaning of such NNCs remains something of a mystery. As observed already by Jespersen (1942: 137), "Compounds express a relation between two objects or notions, but they say nothing of the way in which the relation is to be understood. That must be inferred from the context or otherwise." Stated differently, the meaning of compounds is not entirely *compositional* – that is, deducible from the meaning of their parts – as is often assumed for sentences (for discussion, see Goldberg 1995, 2005; Zlatev 1997). This has been a cause of explicit frustration for many a structurally- or generatively-minded linguist (Lyons 1977: 521–550; Bauer 1978; Ferris 1983: 66).

Attempts have been made to maintain a *semi-compositional* approach by narrowing down the scope of possible interpretations to a set of pre-determined relations. Depending on theoretical orientation, these have been explained as underlying verbs or prepositional clauses (e.g. Lees 1963; Levi 1978; Bauer 1978) or as basic semantic relations such as LOCATION, SOURCE, MATERIAL, RESEMBLANCE, often supplemented by more elaborate and idiosyncratic paraphrases (e.g. Downing 1977; Warren 1978; Mellenius 1997; Wijaya and Gianfortoni 2011). In cognitive linguistics, a range of conceptually less restrained approaches to the meaning of compounds have been developed based on notions such as *conceptual schemas* (Ryder 1994), *blends* (Coulson 2001; Schmid 2011), and *metonymy* (Benczes 2006b; Nesset 2010). While such approaches may explain why some interpretations of existing compounds are more plausible than others, they do not explain the semantic potential of the compound exhaustively, nor predict how a particular instance of a novel compound would be interpreted (cf. Štekauer 2005; Benczes 2006a; Schmid 2008).

The only invariant information deducible from the structure of the NNC itself is that it denotes something (conveyed by the head) that is *somehow related to* something else (conveyed by the modifier). In cases such as (1) and (2), that relation may indeed be specified by simple predicates such as CONTAINMENT and RESEMBLANCE. However, cases such as (3) and (4) call for more elaborate, tailor-made paraphrases, while examples such as (5) are difficult to paraphrase in an unambiguous and sensible way altogether.

(1) *butter cookie* ≈ 'cookie which contains butter'

(2) *whale shark* ≈ 'shark which resembles a whale'

(3) *water pipe* (for smoking) ≈ 'pipe in which the smoke is passed through water (whereby it is filtered and chilled)'

(4) *air coil* ≈ '(electric) coil with a core of air (instead of a solid core)'

(5) *monkey wrench* ≈ ?

What tends to be neglected in approaches looking for a finite set of semantic relations is that paraphrases like those given above are not sufficient to explain the full whole-word meaning. It takes more than 'resembling a whale' to be a *whale shark* and more than 'containing butter' to be a *butter cookie*. As stated by Libben (2006: 11): "In the best of cases, only the reverse is true: that the semantic functions of the constituents can be predicted from the meaning of the whole word." It has therefore been argued that, for conventional compounds, the relation between the constituents serves as an optional "cue" that is not strictly required for connecting the expression with the established whole-word meaning (Wüster 1959/60: 191; Smith 2001). Experimental evidence pointing in the same direction is considered in 2.2 below.

For conventional NNCs such as (1) to (5), therefore, the appropriate interpretation of the noun-noun relation will often be given in advance by their generally acknowledged whole-word meaning. For novel NNCs such as *bird phone* and *Copenhagen banana*, however, the situation is different. Here the meaning of the constituent nouns is all there is to rely on semantically and the hearer is left to construct a contextually relevant meaning, constrained by world knowledge and any cues provided by the context. Zlatev et al. (2010) argued that this is a matter of *pragmatic* inference-making rather than pre-determined lexical semantics (unlike for conventional NNCs), even if some NNCs may be more biased towards some interpretations than others.

Under some circumstances, however, this also seems to be the hearer's first step towards *acquiring* a more permanent lexical meaning: namely, (a) when the NNC happens to have one already (like *air coil*, the exact meaning of which is probably unfamiliar to most readers); or (b) when an established whole-word meaning is about to crystallize through the repeated encounters between the novel NNC and still new hearers in running discourse. The latter scenario can be seen as an instance of lexicalization in progress materializing in the same kind of linguistic interaction that once made *mouse mat* and *home banking* permanent entries in the English lexicon. From this perspective, the speaker's attempts to interpret the relation between the constituents of a novel NNC such as *bird phone*

(e.g. 'it's probably a phone shaped like a bird') and any additional pragmatic inferences that this may trigger (e.g. 'it's probably some kind of toy') can be seen as "first drafts" for becoming permanent components in the conventional (semantic) whole-word meaning that the NNC may eventually come to convey. Notably, such meaning elements will often need to be in place even at the very first encounter in order for the recipient to make any communicative sense of the novel word whatsoever. That is, they are not merely the result of a subsequent diachronic process of lexicalization, as is often assumed. The same applies to a third scenario (c) where a hearer is compelled to *re*-interpret a conventional NNC because the context in which it is encountered conflicts with the established whole-word meaning (see the discussion of *bug spray* in 2.2).

All of this makes hearers' spontaneous interpretation of novel/unfamiliar NNCs, and re-interpretations of conventional/familiar ones, important for understanding such fundamental issues of (cognitive) linguistics as the relationship between semantics and pragmatics, the process of lexicalization, and the (non)compositionality of meaning (Langacker 1987; Goldberg 1995, 2005; Zlatev 1997, 2003; Talmy 2000; Croft and Cruse 2004; Jaszczolt 2005; Geeraerts 2010). Still, the majority of empirical studies of online comprehension of NNCs have so far been carried out in the neighbouring field of experimental psycholinguistics (e.g. Libben and Jarema 2006; Krott 2009; Lynott and Connell 2010). Here the main focus is on predicting participants' spontaneous interpretation of the noun-noun relation as a purpose in its own right rather than on the genesis of fully developed lexical meanings. Moreover, the priority given to experimental control sometimes seems to limit generalizability. The novel NNCs that serve as stimuli in psycholinguistic experiments are usually constructed by the researchers themselves to meet the demands of the experimental paradigm and presented to the participants in experimental settings designed without any explicit considerations of the type of real-life communicative situations which they are supposed to simulate.

While this may be sufficient for addressing some research questions, it nevertheless limits the ecological validity of the findings. When someone creates and applies a novel NNC in actual communication, it is normally not just for the pleasure of creating it (though this may be a factor too, especially with children, e.g. Clark 1982). Rather, the aim is to provide a compact (lexical) expression for a piece of semantic information that would otherwise require a more elaborate paraphrase (Štekauer et al. 2005). The very use of a single word suggests the existence of some well-delimited category, thereby adding to the concept-forming power of the expression (Leech 1981: 32; Schmid 2011: 230). In turn, people who encounter the novel NNC in actual communication will normally try to interpret and understand it only if it seems situationally relevant (Sperber and Wilson

1995). One example would be a consumer in a supermarket looking at the name placed on the packaging of an unfamiliar product while trying to figure out what is inside the package and whether it is worthwhile buying.

## 1.2 Aims and scope

The present study aims at bringing the experimental investigation of hearers' spontaneous interpretation of novel and conventional NNCs a step closer, on the one hand, to the sorts of real-life linguistic interaction in which these processes in fact materialize, and, on the other hand, to general linguistic issues such as lexicalization and the semantics/pragmatics relationship. To this end, we investigate a set of tightly interwoven questions which have mostly been addressed separately in the existing (mainly psycholinguistic) experimental literature: (a) the predictability of interpretation of novel NNCs; (b) the degree to which conventional NNCs are subject to decomposition and semantic interpretation in the same way as novel NNCs; and (c) the impact of context. As a springboard for doing so and to enhance ecological validity, we address a field of real-life activity where the issues mentioned are all subject to explicit societal concern: the naming of commercial food products and, specifically, the question of whether and how food manufacturers are likely to mislead consumers by the names given to the products. To keep the number of semantic variables manageable, we concentrate on the highly productive subtype of compound food names where the modifier denotes a geographical entity and the head denotes a type of food, in short: Place-Food NNCs, as illustrated by *Parma ham* and *Copenhagen banana*. Our actual experimental stimuli were Danish NNCs, which was motivated both by the real-life discourse addressed (see 1.3 below) and the deficit of compound studies addressing languages other than English (cf. Libben and Jarema 2006).

## 1.3 Setting the ecological scene: What's in a (food) name?

Our reference to real-life naming practices relies on an in-depth review of Danish administrative and legal practices on misleading food naming and labelling (Smith et al. 2009; Møgelvang-Hansen 2010) which mirrors the situation in many other EU countries (Howells et al. 2006; MacMaoláin 2007). In disputes on potentially misleading food naming, it is generally taken for granted by all parties that a composite food name can have only one "objective" and/or "linguistically correct" reading, the question being which. In the case of Place-Food NNCs, the authorities usually take the "objective" reading to be an indication of the *physical*

*origin* of the product. That is, *Parma ham* should come from the Parma district in Italy, not from Düsseldorf. "Incorrect" names like *Brussels sprouts* and *French fries* are reluctantly accepted for established (legally also referred to as "generic") names, but for novel names judgments are less liberal.[1]

It is occasionally recognized that other labelling[2] elements on the packaging (brand names, verbal claims, pictures, colours, etc.) may push the consumer's understanding of the name in a more or in a less misleading direction. For example, a name like *Franske vafler* 'French wafers' (on a product not coming from France) is liable to be banned despite its "generic" character if the packaging carries the colours of the French flag and a photo of the Arc de Triomphe. However, decisions on such matters are presently based on case-by-case common-sense judgments relying on no explicit theorizing beyond the sphere of jurisprudence.

In the following, we transpose the pre-theoretical assumptions and arguments summarized above into more exact theoretical terms, stating them as a set of explicit *research questions* (RQs) which can be subject to experimental testing, and thereafter related to the theoretical issues introduced in 1.1. Apart from contributing new insights and a new type of empirical evidence to the theoretical debate on the meaning of NNCs, our aim was to widen the scope of applicability for linguistic research to the improvement of future best practices in the field of food naming and labelling.

# 2 Major research questions

## 2.1 Interpreting the noun-noun relation

While the layman idea of "objective" interpretations of NNCs is hardly in line with (cognitive) linguistics, there is definitely a basis for talking about *default* interpretations for novel NNCs, i.e. such interpretations that tend to be preferred

**1** Such product names should not be confused with manufacturer-specific trade names for individual products like *Nellie Dellies* (wine gum) or master-brands like *Nestlé* which have some linguistic traits in common with proper names and are subject to different legal provisions (Riezebos 2003; MacMaoláin 2007). In addition to such names, all products sold in the EU must carry an "ordinary" name which specifies the product type (Directive 2000/13/EC). Although the borderline sometimes gets blurred, it was the latter sort of names (actual or fictitious) that constituted the intended targets of our experiments.

**2** In accordance with EU Directive 2000/13/EC, Article 1,3(a), we will refer to all potentially informative design elements on food packages as *food labelling* (consisting of various *labelling elements*) using these terms in a somewhat broader sense than in ordinary language.

to others if nothing speaks against them (Zlatev et al. 2010). An extensive literature has been devoted to predicting such interpretations, primarily in experimental psycholinguistics. Thus, our first set of research questions can be stated as follows:

RQ 1a: To what extent and why can the product's physical origin be considered a default interpretation for novel (unfamiliar) Place-Food NNCs?
RQ 1b: What factors may nevertheless interfere with such an interpretation?

One line of addressing such questions in the psycholinguistic literature may be called the *analogy approach*: It has been pointed out that the frequency with which the compound constituents are used with similar interpretations in other, already existing compounds (or, alternatively, in compounds presented immediately before the target NNC during the experiment) affects the recipient's interpretation of the novel NNC (Jaarsveld et al. 1994; Gagné and Shoben 1997; Tagalakis and Keane 2005; Estes and Jones 2006; Krott 2009). Another line, emerging from theories of conceptual integration (Fauconnier and Turner 2002; Ran and Duimering 2010), is the *slot/filler* approach: If the modifier noun denotes something that could naturally serve as a filler for a salient slot in the cognitive structure of the concept conveyed by the head noun, then the corresponding interpretation will be preferred (Smith et al. 1988; Murphy 1990; Wisniewski 1996; Estes and Glucksberg 2000; Gill and Dubé 2007; Veale and Hao 2008; Lynott and Connell 2010).

While some authors stress the opposition between the two approaches (e.g. Gagné and Spalding 2006b), others see them as complementary (e.g. Štekauer 2006: 491–492). Moreover, both approaches seem compatible with but are seldom related to the notion of superordinate *cognitive schemas* developed in cognitive linguistics (Langacker 1987; Croft 2001; Bybee 2006), although Ryder (1994) offers an extensive integrative account. From a cognitive-linguistic viewpoint, furthermore, metonymy has been argued to provide a suitable framework for explaining the links between (what we above call) slots and fillers in NNC interpretation (Benczes 2006b; Nesset 2010). The understanding of conceptual metonymy underlying these analyses can be summarized as "a cognitive process in which one conceptual entity, the vehicle, provides mental access to another conceptual entity, the target, within the same cognitive model" (Radden and Kövecses 1999: 21).

Regardless of the exact paradigm preferred, both analogy/frequency and conceptual compatibility would seem to support the assumption that for novel Place-Food compounds the default interpretation is that the product originates (physically) in the place in question. From the analogy perspective, a great many existing NNCs such as *Parma ham* and *California raisins* do conform to this

pattern. From the compatibility perspective, one can plausibly argue that the place of origin is a conceptually more salient attribute (slot) in our conceptualization of many food products than of such non-food products as toothpaste, entailing additional expectations in terms of culinary traditions, ingredients, and the like. In Experiment 1, we put these considerations to empirical test.

But what, then, may potentially interfere with the alleged default interpretation? Factors mentioned by the actors in real-life disputes on these matters (see 1.3) include the existence of a conventional meaning which is commonly known *not* to presuppose physical origin (e.g. in *Hawaii pizza*) and the possible interference of the surrounding labelling (i.e. the context). Taken together, the theoretical paradigms just introduced would seem to suggest an additional, third factor: mismatch between the constituents of the NNC and the hearer's expected background knowledge. While <physical origin> may well be a salient slot in the concepts of most food products, naturally "attracting" modifiers specifying it, a modifier like *North Sea* would still be more "attractive" than *Sahara* if the head is *herring*. In such cases, the hearer is likely to search for alternatives in analogy with other, familiar food names. Such alternatives are readily available: a great many conventional Place-Food NNCs in Danish (as in English) do *not* presuppose physical origin, but must be explained in terms of such factors as traditional recipe (*spaghetti Bolognese*), characteristic ingredients (*Provence herbs*), historical link (*Madras curry*), and source of inspiration (*Texas burger*).

Notably, in the latter cases the Place-name does not fit directly into the head concept in its capacity as such, filling a physical-origin slot. Rather, it evokes particular salient attributes connected with the Place in a culinary context such as RECIPE and INGREDIENTS with a potential for filling a variety of slots. Such whole-for-part associations based on conceptual contiguity, regarded as (conceptual) metonymy in cognitive linguistics, play a fundamental role in human sense-making well beyond compounding (Radden and Kövecses 1999; Peirsman and Geeraerts 2006). However, since selective property mapping of this sort involves a choice between several rather different alternatives – increasing the processing effort – a search for such alternatives is likely to occur only if a cognitively more straightforward interpretation in terms of physical origin is directly contradicted by the hearer's general world knowledge (Wisniewsky and Love 1998).

## 2.2 Context and (de)compositional processing

The degree to which both linguists and practitioners are preoccupied with (what we here call) the default interpretation may seem somewhat narrow-sighted. In essence, the default interpretation comes down to the hearer's "best shot" for

lack of any other cues. Yet, in actual communication, novel NNCs will usually be encountered in some sort of situational and/or verbal context which will contain additional information. Investigating the role of this information for understanding conventional and novel NNCs leads to the following questions:

RQ 2a: To what extent and how can the context in which a Place-Food NNC is encountered alter a pre-contextually preferred interpretation, be it in terms of physical origin or an alternative one?

RQ 2b: Is the sensitivity to context different for novel (unfamiliar) NNCs compared to conventional (familiar) NNCs, considering that the latter already have a conventional (i.e. socially established) whole-word meaning which may either presuppose (e.g. *Parma ham*) or contradict (e.g. *Hawaii pizza*) an interpretation in terms of physical origin?

Gagné et al. (2005) tested the impact of *sentential context* on the interpretation of novel NNCs for which a pre-contextually preferred interpretation had been established in a preceding experiment. It was found that context was indeed capable of overturning that interpretation by suggesting an alternative one. In addition, the study demonstrated that the context could make at least some hearers re-interpret a conventional NNC and understand a well-known compound such as *bug spray* as 'spray produced by bugs' instead of 'spray for [killing] bugs' when embedded in sentence (6), whereas the conventional interpretation prevailed in sentence (7).[3]

(6) As a defence mechanism against predators, the Alaskan beetle can release a deadly *bug spray*.

(7) Because it was a bad season for mosquitoes, Debbie made sure that every time she went outside she wore plenty of *bug spray*.

These results make a strong case for seeing context as the final and decisive factor in NNC interpretation. But can it "save" just any NNC from being interpreted in an unintended, and potentially misleading, way? Will there not be some form of resistance (perhaps, varying in degree) from the established whole-word

**3** To be precise, Gagné et al. (2005) speak of *familiar* (vs. novel) modifier-noun phrases whereas we here speak of *conventional* (vs. novel) noun-noun compounds while reserving the terms *familiar* for addressing the status of such lexical units with individual hearers. These variations of terminology have no bearing on the points made here, but are of relevance for the general theoretical discussion in Section 5.

meaning of conventional NNCs or the pre-contextually preferred interpretation of novel NNCs? Other methodological and theoretical issues in need of further consideration are how to construct contexts that are closer to those in which people are likely to encounter NNCs in real life, and to explain *how* the context exerts its effect.

The susceptibility of conventional NNCs to compositional (re-)interpretation, and hence to contextual influence in the first place, requires some comments in its own right. Much experimental investigation has been dedicated to assessing whether conventional NNCs and other morphologically complex lexical expressions are decomposed and interpreted compositionally during normal language comprehension, or stored and retrieved from semantic memory as indivisible wholes (e.g. Manelis and Tharp 1977; Gibbs 1989; Sandra 1990; Andrews and Davies 1999; Aitchison 2003: 126–136; Libben 2006; Ji et al. 2011). The results and their interpretation are not unequivocal, but they generally seem to suggest that automatic decomposition either does not take place or may play a certain role in word recognition without affecting whole-word semantics.[4]

Challenging the mainstream views, Gagné et al. (2005) interpreted their findings as evidence of the opposite: that conventional compounds are not only automatically decomposed, but interpreted compositionally according to the context precisely like novel ones. The fact that conventional NNCs tend to be processed faster than novel ones (as demonstrated in several studies) is then explained as an influence from the many previous contextually supported activations of one particular semantic relation in preference to others (i.e. as an instance of analogy). Still, at least on the face of it, the following explanation seems equally if not more likely: The identification of the meaning of a conventional NNC during online language comprehension will require compositional semantic analysis *if and only if* the surrounding context contradicts their established whole-word meaning. In that case, the context will force the hearer to disregard the familiar meaning and "start from scratch"; that is, treat the NNC *as if* it were new.

**4** There are several intermediate positions, including dual and multiple route models presupposing that full-form-based processing and (de)compositional processing may go hand in hand or at least compete with each other up till a certain point. Moreover, factors such as semantic transparency, word length, and others have been hypothesized to affect the processes of both recognizing the word form and determining its meaning. For reviews, see Schmid (2008, 2011); Kuperman et al. (2009). However, our primary concern in this study is with (de)compositional versus whole-word semantics and, in particular with Gagné et al.'s (2005) radical suggestion that the noun-noun relation needs to be (re)established "from scratch" at each new encounter for conventional and novel NNCs alike. We therefore restrict ourselves to considering the findings and debates of previous research in that light.

Whatever is the most plausible explanation, the ease of processing of novel versus conventional Place-Food NNCs both in isolation and in context clearly calls for attention. In Experiments 1 and 2, therefore, we supplemented measures of preferred interpretations with measures of processing effort, as expressed by reaction times (RTs), in order to shed additional light on the following general research questions while possibly adding new evidence to the above-mentioned debate.

RQ 3a: Do novel and conventional Place-Food NNCs trigger different processing patterns, for example, in terms of decomposition and subsequent compositional semantic analysis, versus direct retrieval of a pre-established whole-word meaning when such NNCs are encountered in isolation?

RQ 3b: Will the ease of processing of the respective types of NNC be affected differently when a verbo-visual context operates "on top of" the built-in semantic potential?

Returning to RQ2a/b, additional issues concern *how* the context exerts its impact whenever it is allowed to do so. The sort of context of primary interest in the present case consists of words, texts, and pictures on the surrounding labelling. Such *verbo-visual* contexts differ from sentential contexts in at least two essential respects. First, the name is not syntactically and/or orthographically "embraced" by the context, but stands on its own. This means that the viewer does not, in principle, need to consider any additional cues when wondering about the meaning of a name like *Uganda yoghurt* on the package of a novel product. Second, the contextual cues available are not only verbal (e.g. a verbal claim like *Go tropical with us!*) but also visual (e.g. a picture of an African landscape), and hybrids (e.g. a brand name in characteristic fonts and colours, or a *Fairtrade* logo).

A key consideration, therefore, is how the viewer will distribute visual attention on the total labelling and how this will affect the retrieval of information (Pieter and Warlop 1999; Clement 2007; Smith et al. 2011: 99–100). Visual perception is characterized by frequent shifts between (a) *goal-driven* attention which works top-down when, for example, a consumer is looking for additional information to understand an unfamiliar product name (cf. Buswell 1935; Yarbus, 1967), and (b) *stimulus-driven* attention, which works bottom-up and is triggered by inherent properties of the stimulus (Treisman and Gelade 1980; Itti and Koch 2000; for a review, see Pashler 1998). Pictures and high contrast colours, for instance, attract visual attention automatically, thereby potentially interrupting goal-driven search processes (Itti and Koch 2000; Frey et al. 2011). Yet pictures convey a certain semantic content in their own right (Messaris 1997; Bone and France 2001) which may contribute to disambiguating an unfamiliar name.

In short, a reciprocal interplay between visual prominence and communicative impact can be expected, and we need to learn more about how such complex verbo-visual decoding procedures unfold online in the case of food labels.[5]

### 2.3 Preview of experiments

These research questions were investigated in two complementary experiments. In both, participants were presented with novel and conventional Place-Food NNCs. For each NNC, the participants were asked to judge, by means of a five-point scale, whether the place name referred to the physical origin of the food product or to something else. The first experiment presented the NNCs in isolation, whereas the second experiment presented the NNCs in the verbo-visual context of a schematized food label. In the first experiment, the rating task was combined with the recording of the participants' reaction times (RTs). In the second experiment, the rating task was combined with the recording of the participants' reaction times (RTs) and eye movements, using eye-tracking technology. The design was significantly extended compared with a previous study (Zlatev et al. 2010) by including: (a) both novel and conventional NNCs; (b) verbo-visual contexts in contrast to purely sentential contexts; and (c) RT and eye-tracking data. In turn, this opens up new perspectives on the theoretical issues introduced in Section 1, and contributes to the knowledge basis for identifying and preventing potentially misleading food naming and labelling.

## 3 Experiment 1: Interpreting novel and conventional Place-Food NNCs in isolation

### 3.1 Objectives

The first objective of Experiment 1 was to investigate the extent to which an interpretation in terms of the physical origin of the food product can be considered a *default* interpretation for novel (unfamiliar) Place-Food NNCs (RQ 1a) and whether certain compositional features may nevertheless interfere with such an

5 In earlier research on NNC interpretation, the use of visual primes has been restricted to isolated pictures (e.g. Raffray et al. 2007) whereas studies on the visual examination of realistic product labels (e.g. Clement 2007; Tonkin et al. 2011) have not specifically addressed the interpretation of NNC product names. Our study brings the two perspectives together.

**Table 1:** Place-Food NNCs used as stimuli in Experiment 1

| | |
|---|---|
| **Set A** | 12 novel Place-Food NNCs constructed *not to compositionally contradict* the physical-origin interpretation, e.g. *Lyon-paté* ('Lyon paté'). |
| **Set B** | 12 novel Place-Food NNCs constructed to *compositionally contradict* the physical-origin interpretation in view of the recipients' expectable world knowledge, e.g. *Amazonas-kylling* ('Amazonian chicken'). |
| **Set C** | 12 conventional Place-Food NNCs with a pre-established whole-word meaning *presupposing* the physical-origin interpretation, e.g. Samsø-kartofler ('Samsø potatoes') which denotes a special kind of Danish potatoes grown only on the island of Samsø. |
| **Set D** | 12 conventional Place-Food NNCs with a pre-established whole-word meaning *not presupposing* the physical-origin interpretation, e.g. *Hawaii-pizza* ('Hawaii pizza') |

interpretation pre-contextually (RQ 1b). The second objective of the experiment was to compare the processing effort required for interpreting novel as opposed to conventional NNCs when encountered in isolation as measured by RTs (RQ 3a). We were also interested in possible differences in processing effort (RTs) within these two categories.

## 3.2 Materials

Four sets of Place-Food noun-noun compounds (NNCs) were generated with 12 examples in each (Table 1).

Apart from providing a basis of comparison with the novel NNCs as regards processing effort, by including conventional NNCs (sets C and D) in the stimulus set we intended to make the task more realistic for the participants and to exemplify for them both the origin and the non-origin options. A more practical motivation was to have a basis for selecting the most representative examples from all four sets for Experiment 2.

Set A was generated by the authors from a bulk list of place and food names compiled for a previous study (Zlatev et al. 2010). First, we selected the names of two Danish cities and two Danish locations, two EU cities and two EU locations, and two non-EU cities and two non-EU locations.[6] Second, we combined each

**6** Cities and locations in the United States were excluded due to cultural-historical reasons: while being "outside the EU", its cities and regions may be considered to be at least as familiar, if not more so, for average Danish participants.

place name with a different food name, ensuring that the resulting NNCs satisfied the following criteria: (a) they were not familiar to us beforehand; (b) they sounded to us like plausible food names; and (c) they did not seem to exclude an interpretation in terms of physical origin *a priori*. Examples are *Ribe-ost* ('Ribe cheese'), *Schwarzwald-honning* ('Schwarzwald honey'), and *Nairobi-te* ('Nairobi tea'). In addition, we tried to ensure some variation in terms of product category, durability, and complexity. Finally, we checked the novel status of the NNCs through Google searches on Danish websites; those NNCs that turned out to exist after all were replaced.

The three remaining sets were generated with the help of colleagues at Copenhagen Business School by means of several email brainstorms. For set B, we asked colleagues to invent fictive Place-Food NNCs which they had never heard of before and for which they considered it highly unlikely that the place name could be understood as indicating the physical origin of the food product. Judging from the 25 suggestions received, possible reasons for excluding physical origin included: (a) the physical impossibility of a food product coming from a particular place (e.g. *Greenland papayas*); (b) the durability of the product being inconsistent with the distance between the place and the hearer's reference point (e.g. *Havana sandwich*); and (c) the hearer's general expectations on the potential origin(s) of a particular category of food products when encountered in a Danish supermarket being inconsistent with the place (e.g. *Tanzania pizza*).

For sets C and D, we asked colleagues to make two lists of Place-Food NNCs with which they were familiar: one list with names for which they were sure that the place actually indicated physical origin, and one list with names for which they were sure that that the place did *not* indicate physical origin. More than 100 partly overlapping suggestions were received. For all of the suggested NNCs, we checked facts about whether or not physical origin was indeed a mandatory part of the words' definition and found out that the informants were misguided in some cases. We ensured that sets B, C, and D contained the same distribution of place names as set A in terms of Danish, EU, and non-EU cities and locations. To achieve this, we needed to add a few examples identified by ourselves which were checked and validated like the rest.[7]

**7** All Danish target NNCs were spelled with a hyphen connecting the two constituents which would be a correct spelling for any Danish noun-noun compound (though other variants exist). For some combinations, a connector was inserted as well to comply with specific phonological/orthographical conventions, e.g. *-s-* in *Langelands-asparges* 'Langeland asparagus'.

## 3.3 Method

### 3.3.1 Participants

Fifty BA and MA students at Copenhagen Business School (34 female; age range 18 to 36 years; mean age 22.8 years) participated in the experiment in return for a cinema ticket with a monetary value of 75 Danish kroner. Each participant had either normal or corrected-to-normal vision.

### 3.3.2 Apparatus

The experiment was run on an IBM-compatible laptop computer. The presentation of stimuli and the recording of responses were controlled by E-Prime software (Psychology Software Testing, Pittsburgh, PA). The stimuli were presented on an LCD monitor: the display size was 15.4 inches (39.1 cm) measured diagonally, the aspect ratio was 5:3, and the resolution was 1280 × 768 pixels. The viewing distance was approximately 70 cm. Responses were entered on the keyboard. The statistical analysis of both the rating and the reaction time data was performed using IBM SPSS Statistics for Windows (Version 19.0; IBM Corp., Armonk, NY).

### 3.3.3 Procedure

The participants were given both verbal and written instructions regarding the objectives of the given task. It was explained that the general objective was to interpret Place-Food noun-noun compounds, while the specific objective of the task was to answer the question: Does the place name refer to *physical origin* (where the food product in itself comes from)? The response options were provided by a five-point Likert-type scale:

| | |
|---|---|
| *JA, meget sandsynligt* (YES, very likely) | response key labelled *J* |
| *JA, sandsynligt* (YES, likely) | response key labelled *J* |
| *Hverken/eller* (Neither/nor) | response key labelled *50/50* |
| *NEJ, usandsynligt* (NO, unlikely) | response key labelled *N* |
| *NEJ, meget usandsynligt* (NO, very unlikely) | response key labelled *N* |

Although the key question was posed in a single-barrelled fashion – to allow for both ease of conception and a uni-dimensional response scale – it was

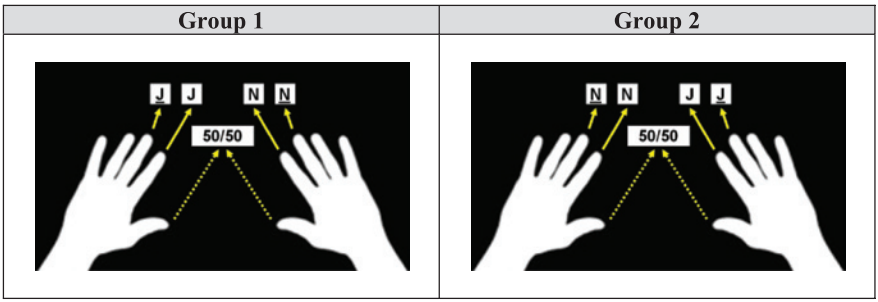


**Fig. 1:** Setup for Experiment 1

emphasized that the implication of the question was double-barrelled: viz., if the place name *does not* refer to physical origin, then it *does* refer to something else. Furthermore, we took care to explicitly suggest that "something else" might cover several possibilities: It was said that food names of the present type sometimes refer to physical origin of the product, and sometimes to something else such as the origin of the recipe (only), a source of inspiration, a historical connection, or a free association. Examples of well-known NNCs covering either the origin option or obvious alternatives were given in the instructions for clarification.[8]

The participants were instructed that they should interpret the Place-Food NNC as if they had seen it on a food package in a Danish supermarket, and that they should respond as quickly and spontaneously as possible.

Because reaction times were to be recorded, the participants were instructed to place their fingers on the keyboard in a specific way (see Figure 1). Given that the middle and index fingers can be moved relatively independently and at roughly the same speed, the middle and index fingers of both hands were used for entering the "yes" and "no" responses. The two thumbs were used interchangeably for the "50/50" response. In order to account for the effects of handedness and the potential dominance of the right hand, the participants were divided into two groups of 25: the first group pressed the "yes" keys with the left hand and the "no" keys with the right hand, whereas the second group pressed the "no" keys with the left hand and the "yes" keys with the right hand. The female and male

**8** The design was thus a compromise between a free interpretation task (e.g. Mellenius 1997; Krott and Nicoladis 2005) and a fixed-choice task with two or more options identified and selected by the experimenters in advance (e.g. Gagné et al. 2005; Zlatev et al. 2010). We thereby intended to allow for a wider array of alternative interpretations than in the fixed-choice design while still retaining an unambiguous measure for the physical origin option.

participants were divided equally between the groups. Each group contained four left-handed participants.

The practice session consisted of eight trials, randomly ordered. The active session consisted of 48 trials, randomly ordered, with a break after the 24th trial. Each trial consisted of five displays. In the first display, the question was presented at the top of the screen, and an oval frame at the bottom of the screen. After a short delay, a fixation cross appeared in the centre of the oval frame. In the fourth display, the place/food NNC was presented in the centre of the oval frame. Finally, the fifth display provided feedback in the form of a five-point scale with the participant's answer highlighted. This feedback served two purposes: first, to confirm the participant's response; and second, to reinforce the stimulus-response mapping.

## 3.4 Predictions

We predicted a significant difference in mean rating scores for the novel NNCs in sets A and B, respectively, with set A tending towards the higher endpoint of the scale ('YES physical origin very likely') and set B tending towards the lower endpoint of the scale ('NO physical origin very unlikely'). A similar pattern was more trivially expected for the conventional NNCs in sets C and D since these NNCs had been carefully selected by us to either presuppose or not presuppose physical origin by virtue of their pre-established whole-word meanings. We considered the ratings for these NNCs important as a basis of comparison and as a reality check of our own stimulus selection.

In terms of reaction times (RTs), we predicted that the conventional NNCs (sets C and D) would be processed faster (give rise to shorter RTs) than the novel NNCs (sets A and B), following the assumption that the whole-word meaning of the conventional NNCs would be assessed directly, whereas the novel NNCs would need to be first broken down into their constituents and the meaning of the constituents thereafter integrated by a process of pragmatic inference. We furthermore expected that the novel NNCs in set A would be processed faster (give rise to shorter RTs) than those in set B since the former would follow the expected default interpretation whereas the latter would require the participant to consider a variety of alternative interpretations, necessitating additional processing. We were, however, open to findings offering possible support for the alternative analysis suggested by Gagné et al. (2005); that is, that conventional NNCs are decomposed and interpreted compositionally just as novel ones, but processed faster due to the many previous activations of the semantic relation in question. An observation of potential interest would be if a difference in RT would also occur

for the conventional (familiar) NNCs in sets C and D, depending on whether they supported the expected default interpretation (i.e. physical origin) or an alternative one.

## 3.5 Results and discussion

### 3.5.1 Analysis of rating scores

For the analysis of the rating scores, the verbal scale was converted into a numerical scale, ranging from 1 ('physical origin very unlikely') to 5 ('physical origin very likely'). The mean scores were calculated for each of the 50 subjects and for each of the four categories of NNCs (see Figure 2). The statistical analysis of the mean rating scores was done using planned paired-sample *t*-tests. For the novel NNCs, the mean rating scores for the NNCs constructed not to contradict the physical-origin interpretation (set A) were significantly higher than the NNCs constructed to contradict that interpretation (set B) which was in line with our predictions (3.54 vs. 2.08; diff. = 1.46; $t(49) = 18.000$, $p < 0.001$).

As trivially expected, a similar pattern was observed for the conventional NNCs (sets C and D): that is, the NNCs that were classified as presupposing physical origin were rated higher than the NNCs that were classified as not presupposing physical origin (3.94 vs. 2.57; diff. = 1.37; $t(49) = 13.989$, $p < 0.001$). However,

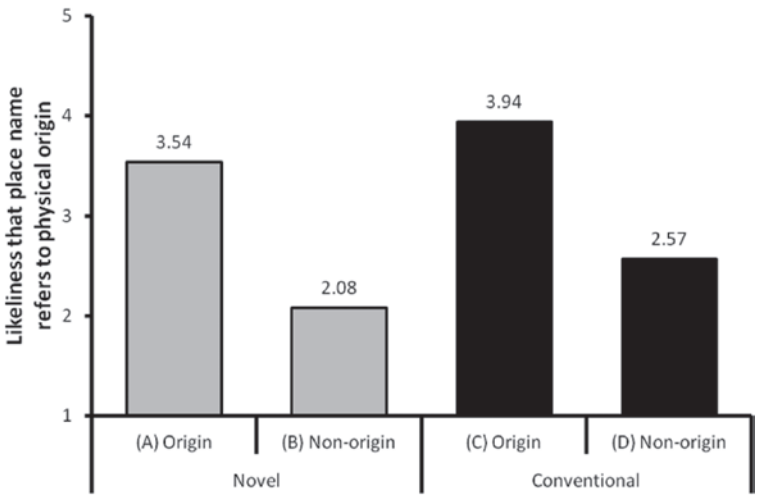


**Fig. 2:** Mean rating scores for Experiment 1 (all NNCs)

the moderate strength of these results triggered some additional methodological considerations (see below).

Though predicted, the marked difference in rating scores between the novel NNCs in sets A and B was by no means given in advance. The NNCs in set A had been constructed so as to not compositionally *contradict* physical origin, but this does not imply that other interpretations were excluded. For example, nothing about *Lyon-paté* 'Lyon paté' excludes that it could be interpreted by some people as a 'paté made according to a recipe from Lyon', a 'paté made from ingredients typical of Lyon', a 'paté invented by a chef who once visited Lyon', and so on. Moreover, 12 conventional NNCs (set D) were included to demonstrate and prime for precisely such alternative options while not compositionally excluding physical origin either. Still, for novel NNCs like *Lyon-paté* the majority of participants opted for the straightforward physical origin option. The only factor that could interfere with this trend was the presence of knowledge-based obstacles deliberately built into the NNCs in set B. This suggests that physical origin is indeed a plausible default for the present type of NNCs (cf. RQ 1a), but still sensitive to specific compositional factors (cf. RQ 1b). The latter confirms that slot-filler compatibility must be obtained for each individual modifier-head pair and not only on the generic level of the Place-Food schema.

As for the conventional NNCs, the moderate strength of the results was rather surprising. Given that some participants tend to avoid the extremes of a scale, we expected a mean score between 4 and 5 for set C and a mean score between 1 and 2 for set D. While the mean score for set C at least approached the expected level (3.94), the mean score for set D was some distance removed (2.57). By examining the data further, we found that some participants had indeed interpreted some of the conventional NCCs *contrary* to their established whole-word meaning. For example, *Parma-skinke* 'Parma ham' (from set C), whose physical origin in the Parma District, Italy, is mandatory according to EU law, was only rated in the middle of the scale (i.e. 3.00). For *Madagascar-peber* 'Madagascar pepper' (from set D), on the other hand, the majority of participants tended to opt for the physical-origin interpretation (4.04), despite the fact that the name refers to a special variety of pepper that can be produced in many different places.

This highlights two closely connected points each of which offers a possible explanation for the unexpected responses (see Street and Dabrowska 2010 for a similar argument pertaining to grammar): (a) that *conventionality* on the level of the language community as a whole does not mean *familiarity* to all its individual members; and (b) that even speakers who are familiar with a given NNC will not necessarily connect it with exactly the same set of semantic features. That is, some of our participants might either not have been familiar with e.g. *Parma-skinke* ('Parma ham') and *Madagascar-peber* ('Madagascar pepper') at all, or if so,

connected them with rather vague meanings which remained underdetermined with regard to physical origin (but not necessarily to more readily recognizable properties such as appearance, texture, and taste).[9] In the latter case, the interpretation of the noun-noun relation – required by our experimental task – would be just as much an instance of qualified guesswork as for the novel NNCs.

Against this background, we decided to include only the "top six" from each of the four sets given in Table 1 (i.e. the best representatives of the overall trends demonstrated for each set) in our analysis of reaction times. The four sets were thus identical to those selected for additional testing in Experiment 2 (see 4.2; Table 2). We thereby hoped to ensure that the conventional NNCs taken into consideration would also have been *conceived* as conventional by a majority of participants, and the noun-noun relation interpreted by them in a way consistent with what had been established for these NNCs pre-experimentally.

### 3.5.2 Analysis of reaction times

Given the potential variance in RTs across the 50 subjects, we chose to define outliers by subject rather than by some less specific criterion.[10] For each subject, the mean RT and standard deviation were calculated. An upper limit was calculated by adding two standard deviations to the mean RT, while a lower limit was calculated by subtracting two standard deviations from the mean RT. The RTs that were outside these limits (3.8% of the total trials) were excluded from the data set and restricted means were calculated. The means of the mean RTs for all 50 subjects and for all four categories are presented in Figure 3.

The main statistical analysis on the mean RTs was done with a 2 (conventionality: novel, conventional) × 2 (origin: supported, non-supported) repeated measures ANOVA. In line with our predictions, the main effect of conventionality was significant: overall, the conventional NNCs were processed faster (gave rise to shorter RTs) than the novel NNCs, $F(1, 49) = 4.843$, $p < 0.05$. In addition, the main

**9** The examples suggest that what is a mandatory semantic feature to some hearers may be optional encyclopaedic/culinary background knowledge to others. A way of dealing with such examples theoretically seems to lie in a cognitively founded (re)formulation of Putnam's (1975) hypothesis of "division of linguistic labour", as suggested by Smith et al. (2010) and tested experimentally in Smith et al. (2012).

**10** Outliers can be defined in a number of different ways: in order of specificity by group, by both group and condition, by subject, and by both subject and condition. We did not define outliers by both subject and condition because of the relatively small number of trials per condition: six trials per condition in Experiment 1 and three trials per condition in Experiment 2.

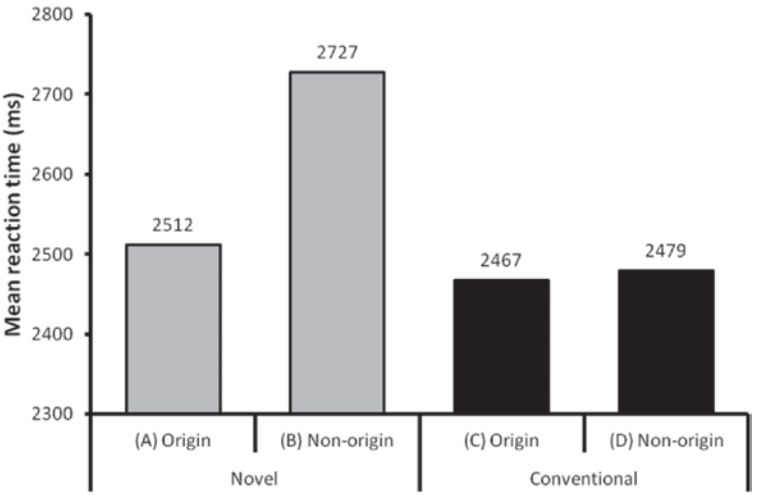


**Fig. 3:** Mean reaction times in Experiment 1 (the "top six" NNCs from each of the four sets, see Table 2 in 3.2 below)

effect for origin was significant, $F(1, 49) = 4.200$, $p < 0.05$, and the interaction between conventionality and origin was marginally significant, $F(1, 49) = 3.350$, $p < 0.10$. Follow-up paired sample T-tests revealed that the significance of these results was driven primarily by the novel NNCs rather than the conventional NNCs: the mean RTs for set A were significantly faster than the mean RTs for set B ($t(49) = 3.268$, $p < 0.01$), whereas the mean RTs for set A were not significantly different from the mean RTs for either sets C or D ($ts < 1$), and the mean RTs for sets C and D were not significantly different from each other ($t < 1$).

The results confirm that an additional effort was needed to process the novel NNCs compared to the conventional ones when both sets were taken as a whole (cf. RQ 3a). However, it is noteworthy that this result was mainly due to set B where the expected default was contradicted on compositional grounds, whereas set A was nearly as fast as sets C and D with a difference not reaching the level of statistical significance. This lends support to seeing the default interpretation as a parameter to be distinguished from both the pre-determined (semantic) whole-word meaning of a conventional NNC and other pragmatic interpretations of novel NNCs which are less cognitively accessible than the default. In turn, the lack of difference in RTs between the conventional NNCs presupposing (set C) and not presupposing (set D) physical origin suggests that their whole-word meanings were accessed directly and allowed the participants to answer the question without having to engage in any further interpretation of the noun-noun relation. No

immediate support was thus found for the claim of mandatory noun-noun interpretation even for conventional NNCs (Gagné et al. 2005).

# 4 Experiment 2: Interpreting novel and conventional NNCs in verbo-visual contexts

## 4.1 Objectives

The first objective of Experiment 2 was to test the potential of contradictory (incongruent) verbo-visual context for overturning a pre-contextually preferred interpretation of a novel NNC – and possibly even inducing an alternative reading of a conventional NNC – through systematic variation of the three key elements *brand name*, *verbal claim*, and picture in a schematized food label (cf. RQ 2a/b). The second objective of Experiment 2 was to assess how the addition of either a non-contradictory (congruent) or a contradictory (incongruent) verbo-visual context would affect the ease of processing of novel and conventional Place-Food NNCs, respectively, as expressed by RTs (cf. RQ 3b).

To learn more about *how* the surrounding context is processed (and whether it is processed at all), we supplemented measures of RTs with measures of the participants' eye movements while performing the task, using an eye-tracking system. If we assume that the so-called eye-mind hypothesis is approximately correct, that is, that the mind tends to process what the eyes are looking at, with a minimal time lag (Just and Carpenter 1980), then eye-tracking data effectively allow us to partition the overall reaction time into a number of different processing times, one for each area of interest (AOI). The key variables analysed were fixation order and total fixation duration for the individual labelling elements.

## 4.2 Materials

Target NNCs were the six highest scoring NNCs from sets A and C and the six lowest scoring NNCs from sets B and D in Experiment 1, i.e. the "top six" in terms of being best representatives of the overall trends demonstrated for the four sets of NNCs, yielding a total of 24 NNCs (see Table 2).

Each of the 24 NNCs was placed in the verbo-visual context of a schematized food label. This context could be either congruent (supporting the pre-contextually preferred interpretation) or incongruent (contradicting the

**Table 2:** The "top six" NNCs from Experiment (highest scoring NNCs from sets A and C and lowest scoring NNC from sets B and D)

| | Novel NNCs, origin-neutral | Mean Score | | Novel NNCs, origin-contradicting | Mean Score |
|---|---|---|---|---|---|
| **A1** | Limfjords-torsk ('Limfjord cod') | 4.40 | **B1** | Sahara-sild ('Sahara herring') | 1.54 |
| **A2** | Langelands-asparges ('Langeland asparagus') | 4.34 | **B2** | Valby-guf ('Valby [icecream] topping') | 1.58 |
| **A3** | Ribe-ost ('Ribe cheese') | 4.20 | **B3** | Amazonas-kylling ('Amazonian chicken') | 1.88 |
| **A4** | Loire-brie ('Loire brie') | 4.06 | **B4** | Saltholms-sushi ('Saltholm sushi') | 1.96 |
| **A5** | Nairobi-te ('Nairobi tea') | 3.98 | **B5** | Toscana-burger ('Tuscany burger') | 1.96 |
| **A6** | Lyon-paté ('Lyon paté) | 3.54 | **B6** | Doggerbanke-dip ('Dogger Bank dip') | 1.98 |
| | **Overall mean** | **4.09** | | **Overall mean** | **1.82** |
| | | | | | |
| | **Conventional NNCs, origin-presupposing** | **Mean Score** | | **Conventional NNCs, non-origin-presupposing** | **Mean Score** |
| **C1** | Samsø-kartofler ('Samsø potatoes') | 4.86 | **D1** | Hawaii-pizza ('Hawaii pizza') | 1.20 |
| **C2** | Middelhavs-salt ('Mediterranean salt') | 4.50 | **D2** | København-stang ('Copenhagen [icecream] stick') | 1.80 |
| **C3** | Stillehavs-laks ('Pacific salmon') | 4.34 | **D3** | Pariser-toast ('Paris toast') | 1.80 |
| **C4** | Odense-pilsner ('Odense pilsner') | 4.28 | **D4** | Amager-mad ('Amager [white-on-rye bread] sandwich') | 1.88 |
| **C5** | Havanna-rom ('Havana rum') | 4.02 | **D5** | Toscana-chips ('Tuscany chips') | 2.12 |
| **C6** | Lammefjords-gulerødder ('Lammefiord carrots') | 4.00 | **B6** | Wiener-schnitzel ('Vienna schnitzel') | 2.48 |
| | **Overall mean** | **4.33** | | **Overall mean** | **1.88** |

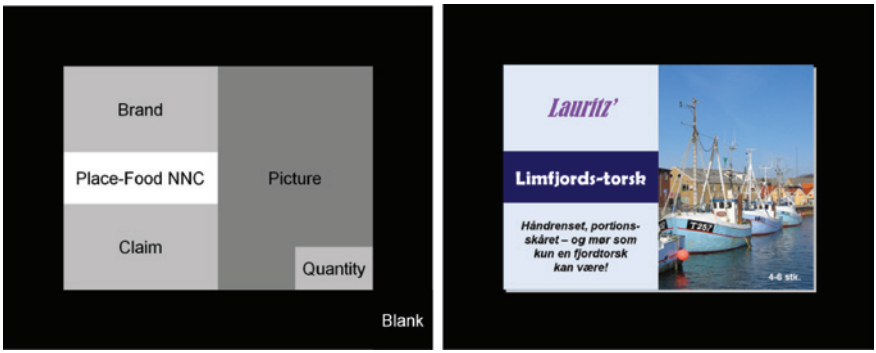


**Fig. 4:** Template and example of actual stimulus used in Experiment 2

pre-contextually preferred interpretation while also providing an alternative to it), yielding a total of 48 stimuli.

For the sake of simplicity and experimental control, all of the food labels were constructed according to a standard template containing pre-defined slots for the following five archetypal elements: *food name*, *brand name, verbal claim*, *picture*, and *quantity information*. All of these elements have a well-defined legal status and play a salient role in real-life disputes on misleading food labelling (FSA 2008; Smith et al. 2011). For each label pair, the food name was held constant whereas the brand name, verbal claim, and picture were varied to achieve the congruent and non-congruent effects. The element *quantity information* (e.g. 300 g) was not varied but included to help create the overall illusion of a food label. Neither was it regarded as an area of interest (AOI) in the eye-tracking data analysis (Figure 4).

To enhance experimental control, we ensured a stronger demarcation between verbal (linguistic) and visual cues than found on actual packages. Thus, the food names and the verbal claims were treated as "100% verbal" with no variation of font type, font size, or font colour across the 48 stimuli. (The food names were presented in Berlin Sans FB Demi 40 and the claims in Arial 24.) The pictures were all figurative naturalistic colour photographs of real-life objects and events containing no immediately readable text. Only the brand names were allowed to appear as verbo-visual in themselves and were varied in terms of font type, font size, and font colour. This was considered necessary to create an illusion of real-life brands. In addition, the background colours were varied between the pairs to imitate a certain variation as on real labels, but kept constant across the two contexts for each NNC (see Kauppinen 2004 for the impact of colours on product packages).

A toolbox of possible biasing effects which could be used to achieve both congruent and incongruent contexts was constructed by considering archetypical uses of the respective elements found on actual packages. Unlike verbal elements, pictures, including figurative ones, are propositionally indeterminate in that they may *refer* to objects and events beyond themselves (by depicting them) but lack the formal devices needed to make explicit propositional statements about them (Messaris 1997; Bone and France 2001; Barratt 2004). What a picture "says" must ultimately be inferred by the viewers at their own risk, resorting, for instance, to the assumption of optimal situational relevance (Sperber and Wilson 1995). However, it is also widely recognized that picture-reading is governed by certain conventions in its own right though the exact nature and degree of generalizability of such conventions is subject to much debate (e.g. Sonesson 1989; Forceville 1996; Messaris 1997; Scott 1994; Kress and van Leeuwen 2006). Still, our present communicative domain is evidently characterized by rather stable (while not indispensable) conventions or archetypes that packaging designers resort to when selecting pictures for food labels. Among the more familiar uses are: picture = product (e.g. biscuits), picture = characteristic ingredient (e.g. hazel nuts), and picture = serving suggestion (e.g. pizza on plate with green salad). Moreover, many of them seem to have (propositionally less indeterminate) verbal counterparts such as *with whole hazelnuts* or *try it with a fresh green salad*.

For both pictures and verbal claims, we therefore decided to rely on a limited selection of precisely such highly stereotypical usages which all instantiated the following cognitive meta-categories (sometimes combining two or more in one) highlighting specific sales arguments within their scope (e.g. *a reborn classic* referring to the product and hence *Content*):

> ***Landmark***, e.g. a picture of a famous building or a typical landscape; a claim like *they just taste better here* (in casu: relying on deixis);
> ***Source***, e.g. a picture of the sea or a farmer's field; a claim like *created by Poul Ørum* (Danish-sounding name of fictitious chef);
> ***Content***, e.g. picture of the product itself or a key ingredient; a claim like *made with mussels and white wine*;
> ***Context of preparation/consumption***, e.g. a picture of a happy family dining or ice cream served at a café; claims like *try it with walnuts and maple syrup* or *ready in 10 minutes*.

These four categories also guided our intuitions when constructing the fictitious brand names, though these were bound to be significantly more elliptic and opaque due to the prevailing conventions for brand names: short, fanciful words and word combinations rendered in fanciful colours and fonts. For example, the

brand name *Frigorix* in slim blue letters was intended to indicate a frozen product and a connection to France.

Drawing on this overall toolbox, a unique combination of biasing effects was selected to create a congruent and an incongruent context for each NNC. For example, in the case of *Langelands-asparges* 'Langeland asparagus' from set A, the congruent context (in this case supporting physical origin) included a brand name referring to "some" island (*Øen's grønt* 'The Island's Vegetables'), a claim praising the superior taste of local farm production, and a picture showing a farmer standing in a field. The incongruent context (in this case supporting non-origin) included a brand name indicating ready-made frozen dinners (*Frigo-Dinner*), a claim focusing on the ingredients (suggesting a special type of recipe rather than a local raw product), and a picture of the product itself (chosen to depict a ready-made dish rather than the vegetable on its own). Thus, while the first verbo-visual context could be expected to support the physical-origin interpretation by priming for the "made in" slot in the head concept for which the Place-name could serve as filler, the latter was meant to dilute it by suggesting alternative conceptual slots requiring more selective, metonymical readings of the modifier.

## 4.3 Method

### 4.3.1 Participants

Fifty BA and MA students at Copenhagen Business School (30 female; age range 19 to 28 years; mean age 22.9 years) none of whom had participated in Experiment 1 were recruited for the experiment in return for a cinema ticket with a monetary value of 75 Danish kroner. Each participant had either normal or corrected-to-normal vision.

### 4.3.2 Apparatus

The experiment was run on two IBM-compatible desktop computers. The presentation of stimuli and the recording of responses were controlled by E-Prime software (Psychology Software Testing, Pittsburgh, PA). The stimuli were presented on an LCD monitor: The display size was 19 inches (48.3 cm) measured diagonally, the aspect ratio was 5:4, and the resolution was 1280 × 1024 pixels. The viewing distance was approximately 70 cm. Each stimulus measured 922 × 666 pixels (27.1 × 19.6 cm) and subtended a visual angle of 21.9 degrees in width

and 15.9 degrees in height. Responses were entered by the participants on a keyboard.

The participants' eye movements were recorded with an iView X RED eye-tracker built by Senso-Motoric Instruments (SMI) GmbH, Berlin. The sampling rate was 50 Hertz.[11] The E-Prime program communicated with the eye-tracker by sending commands via a serial port connection. The statistical analysis of the rating, reaction time, and eye-tracking data was performed using IBM SPSS Statistics for Windows (Version 19.0; IBM Corp., Armonk, NY).

### 4.3.3 Procedure

The objectives of the task, and the general procedure, were the same as for Experiment 1. The key difference was that the Place-Food noun-noun compounds were presented in a verbo-visual context. The 50 participants were divided into two groups of 25. For each of the four categories of NNCs (A, B, C, and D) the first group of participants saw the three highest scoring NNCs in *congruent* verbo-visual contexts and the three lowest scoring NNCs in *incongruent* verbo-visual contexts, while the second group of participants saw the three highest scoring NNCs in *incongruent* verbo-visual contexts and the three lowest scoring NNCs in *congruent* verbo-visual contexts.

The phrasing of the question was the same as in Experiment 1 and hence concerned the name and not the surrounding labelling. The participants were told that the name was placed on the label to help them imagine the product. The same five-point scale and response keys were used. As before, the participants were asked to respond as quickly and spontaneously as possible.

The practice session consisted of four trials, randomly ordered. The active session consisted of 24 trials, randomly ordered, with a break after the 12th trial. Each trial consisted of four main displays. The main eye-tracking calibration was performed before the practice session (using a nine-point calibration). If the experimenter judged that the main calibration had become inaccurate, the program was set up so that a second calibration could be performed after the practice session, and a third calibration could be performed halfway through the active session.

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**11** Andersson et al. (2010) argue that for an eye-tracker operating at a sampling rate of 50 Hertz to achieve the temporal accuracy of an eye-tracker operating at a sampling rate of 1000 Hertz (i.e. with an error margin of less than 1 ms), at least 972 data points (trials) must be recorded. This figure is calculated by the equation $N = cf_s^{-2}$, where $N$ is the number of data points required, $f_s$ is the sampling frequency, and $c$ is the constant 2429400. The current experiment satisfies this criterion with 50 subjects and 24 trials per subject yielding a total of 1200 trials.

## 4.4 Predictions

In terms of rating scores, our key prediction was that the *incongruent* verbo-visual contexts would be capable of shifting the mean scores for the origin-biased NNCs (sets A and C) *down the scale*, and the mean scores for the non-origin-biased NNCs (sets B and D) *up the scale* compared to the congruent contexts (and to the results in Experiment 1). We expected the contextual effect to be relatively stronger for the novel NNCs compared to the conventional NNCs due to lack of resistance from a pre-established whole-word meaning. For the congruent contexts, we expected the scores to replicate the pattern observed in Experiment 1, while possibly being even more pronounced here due to our selecting the six "best" representatives from each set and the presence of a context lending further support to the pre-contextually dominant interpretations.

In terms of RTs, we predicted that the presence of verbo-visual context would increase the overall RTs in comparison with Experiment 1 considering that there would be more verbal and visual material to attend to and process. We furthermore predicted that the mean RTs would be longer in incongruent contexts than in congruent ones because the former contexts would encourage the participants to (re)analyse all four types of NNCs, including the conventional ones, and then (re)consider whatever would otherwise have been the most plausible reading for each of them. We assumed that the most likely outcome would be an even distribution of RTs between the four sets, while being open to other findings. As for the congruent contexts, we expected the conventional NNCs (sets C and D) to be processed faster than the novel NNCs (sets A and B) as we also found in Experiment 1. Our reasoning was that the congruent contexts would not add any new incentives for (re)analysing the conventional NNCs, whereas decomposing and analysing the noun-noun relation "from scratch" would remain the only viable path for the novel NNCs, with or without the help of context. However, we considered it possible that the relative difference observed in Experiment 1 between the novel NNCs in set A (consistent with physical origin) and set B (contradicting physical origin on compositional grounds) would decrease in Experiment 2 because the context would be deliberately constructed to support one among the several possible alternatives for set B (e.g. recipe *or* ingredients *or* inspiration, etc.), thus facilitating a faster decision.

Regarding eye movements, a key prediction was that apart from fixating on the target NNC (as a necessary precondition for meeting the task) in a majority of trials, the participants would also fixate on one or more other labelling elements as a result of either goal-driven attention (looking for cues) and/or stimulus-driven attention (where an element simply catches the eye automatically). Furthermore, we expected to see *some* sort of differences in the participants' dis-

tribution of their visual attention on the various elements depending on whether the context supported or contradicted the pre-contextually preferred interpretation. However, given the lack of previous studies on participants' examination of complex verbo-visual contexts during NNC interpretation, we decided to take an explorative approach and use whichever salient trends the eye-tracking data might reveal as a basis for future work.

## 4.5 Results and discussion

### 4.5.1 Analysis of rating scores

As in Experiment 1, the analysis of the rating scores was done by converting the verbal scale described above into a numerical scale, ranging from 1 ('physical origin very unlikely') to 5 ('physical origin very likely'). The mean scores were calculated for each of the 50 participants and for each of the eight conditions: four categories of Place-Food NNC (sets A to D) and two types of verbo-visual context (congruent and incongruent). The means of the mean scores for all 50 subjects and for all eight conditions are presented in Figure 5.

The statistical analysis of the mean rating scores was done using planned paired-sample *t*-tests. The aim of the first analysis was to check whether the

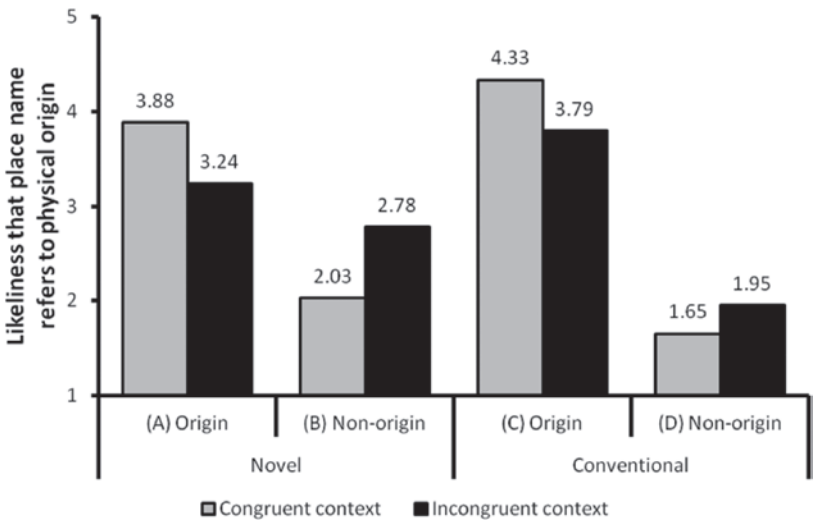


**Fig. 5:** Mean rating scores for Experiment 2

relative ratings of the four sets of NNCs presented in congruent verbo-visual context would follow a similar pattern to that observed in Experiment 1. This was indeed the case. As before, the mean rating scores for the novel NNCs constructed not to contradict the physical-origin interpretation (set A) were significantly higher than the novel NNCs constructed to contradict that interpretation (set B) (3.88 vs. 2.03; diff. = 1.85; $t(49) = 9.540$, $p < 0.001$). For the conventional NNCs (sets C and D), we observed a similar pattern (4.33 vs. 1.65; diff. = 2.68; $t(49) = 17.200$, $p < 0.001$). Moreover, in both comparisons the absolute difference was somewhat higher than in Experiment 1, suggesting that the congruent context did indeed "push" even further in the pre-contextually expected direction.[12]

The aim of the second analysis was to examine the influence of incongruent verbo-visual contexts on the interpretation of the NNCs. First, we compared the ratings for the NNCs presented in congruent contexts with the ratings for the NNCs presented in incongruent contexts, in order to test whether or not the incongruent contexts were capable of moving the ratings in the opposite direction to the congruent contexts (and to the results from Experiment 1). In accordance with our predictions, the incongruent contexts shifted the ratings for the origin-biased NNCs down the scale (from 3.88 to 3.24 for novel, from 4.33 to 3.79 for conventional), $t(49) = 4.026$, $p < 0.001$, and the ratings for the non-origin biased NNCs up the scale (from 2.03 to 2.78 for novel, from 1.65 to 1.95 for conventional), $t(49) = 3.867$, $p < 0.001$. Second, we tested whether the novel NNCs were more susceptible to contextual influence than the conventional NNCs. In order to do this, we compared the mean differences between the congruent and incongruent contexts for the novel NNCs with the mean differences between the congruent and incongruent contexts for the conventional NNCs. This difference was marginally significant, $t(49) = 1.845$, $p < 0.10$. In the incongruent conditions, furthermore, the difference between origin and non-origin presupposing examples was significantly reduced for the novel NNCs compared with the conventional NNCs, $t(49) = 5.070$, $p < 0.001$.

The results confirm that verbo-visual context has the potential to influence the interpretation of conventional, as well as novel NNCs (cf. RQ 2a). However, the hegemony of context was not total and, as in previous research (Gagné et al. 2005), the influence of context was stronger for novel than for conventional NNCs (cf. RQ 2b). For the novel NNCs its influence was sufficient to almost eliminate the difference between origin and non-origin presupposing examples in the incongruent condition, whereas this difference was firmly maintained in the con-

**12** Another contributing factor might be our selection of only the six "best" examples of the four sets from Experiment 1 for Experiment 2.

ventional NNCs in the same condition, showing that novel NNCs are in general more open to alternative interpretations than conventional ones. Still, for none of the four sets of NNC did the context push the mean scores to the opposite side of the equilibrium point (50/50), compared to the congruent condition (and to Experiment 1). This indicates that even if most participants had looked at the elements surrounding the NNC (which was confirmed by the eye-tracking data, see below), the incongruent contexts must still have left some room for diverse interpretations. Also, some participants may simply have ignored the contexts, at least semantically, and stuck to what seemed most plausible by viewing the NNC in itself.

### 4.5.2 Analysis of reaction times

Mean reaction times (RTs) were analysed for each of the eight conditions. As in Experiment 1, we chose to define outliers by subject. For each subject, the RTs that were outside two standard deviations from the mean RT (4.3% of the total trials) were excluded from the data set and restricted means were calculated. The mean RTs for all 50 subjects are presented in Figure 6.

Against this background, we first checked whether the NNCs presented in a verbo-visual context were processed more slowly, i.e. gave rise to longer RTs, than

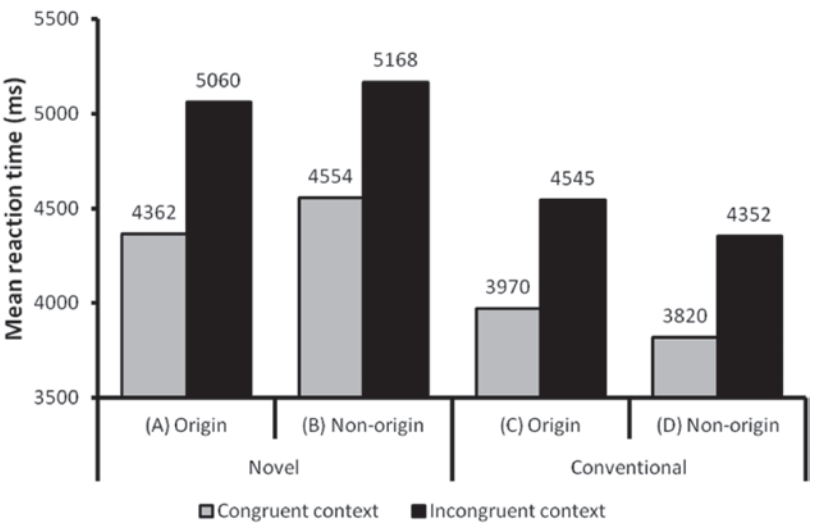


**Fig. 6:** Mean reaction times for Experiment 2

the same NNCs presented in isolation (i.e. the top six NNCs in Experiment 1). A simple analysis of the overall mean RTs revealed that this was indeed the case (4479 ms vs. 2546 ms) in line with our prediction. A more detailed analysis on the mean RTs was done with a 2 (conventionality: novel, conventional) × 2 (origin: origin, non-origin) × 2 (congruency: congruent, incongruent) repeated measures ANOVA. As in Experiment 1, the main effect for conventionality was significant, supporting our expectation that overall judgments about physical origin were made more slowly for novel NNCs than for conventional NNCs, $F(1, 49) = 30.912$, $p < 0.001$. The main effect for congruency was also significant, thus lending support to our prediction that the NNCs presented in incongruent contexts would be processed slower than the NNCs that were presented in congruent contexts, $F(1, 49) = 18.297$, $p < 0.001$. The lack of a significant interaction between conventionality and congruency revealed that the novel NNCs were processed slower than the conventional NNCs in *both* congruent and incongruent contexts, $p = 0.516$. In contrast to Experiment 1, the main effect for origin, and the interaction between conventionality and origin, were not significant, $ps >= 0.204$, which is consistent with our prediction that the difference between novel NNCs of type A and B observed in Experiment 1 would even out in Experiment 2 (see 4.4).[13]

By and large, our expectations were confirmed. Context did add to the processing effort across conditions (cf. RQ 3b). It is noteworthy, however, that even in *incongruent* contexts the conventional NNCs were processed faster than the novel ones. This would indicate that at least some participants retrieved the whole-word meaning directly and replied to the question without (re)analysing the noun-noun relation or trying to make it fit the context. This provides further evidence against the claim that conventional NNCs are always decomposed and then analysed according to context (Gagné et al. 2005). Certainly, in our case all NNCs, including the conventional ones, are bound to be decomposed simply to understand the question of the experimental task, presupposing a degree of metalinguistic reflection (Simard et al. 2007). But if the noun-noun relation was also *analysed* in its own right and the context was *in*congruent, why were they processed faster than the novel NNCs? This can only mean that some participants did not analyse the noun-noun relation, but simply retrieved the well-known whole-word meaning and answered the question on that basis. This does not exclude considering the surrounding context anyway (see below).

**13** We did not have any specific hypotheses about the remaining interactions (origin × congruency and conventionality × origin × congruency) and neither of these interactions was significant, $ps >= 0.782$.

### 4.5.3 Analysis of eye movements

For the analysis of the eye movements, each food label was broken down into four primary *areas of interest* (AOIs): target NNC, brand, verbal claim, and picture (see Figure 4). The objective of the first analysis was simply to ascertain whether or not the participants had actually looked at (i.e. fixated) these four key AOIs. It was found that all four key AOIs were fixated in 59.2% of the trials (across participants), three of the key AOIs were fixated in 24.4% of the trials, two of the key AOIs were fixated in 13.8% of the trials, and only one of the AOIs was fixated in 2.5% of the trials.

The objective of the second analysis was to examine *how* the participants examined the four key AOIs across all four conditions. The main variables used were total fixation time (the sum of durations for all fixations that hit the AOI) and fixation order (the order in which the AOI was fixated in relation to the other AOIs). For the analysis of fixation times (see Figure 7), a one-way repeated measures ANOVA revealed that the difference between the four key AOIs was significant in terms of fixation duration, $F(3, 147) = 6.000$, $p < 0.01$.

On average, the participants spent 1,223 ms looking at the target NNC, 946 ms looking at the brand, 925 ms looking at the claim, and 802 ms looking at the picture, with the difference between the target NNC and the picture (finishing first and last, respectively) being significant, $t(49) = 4.318$, $p < 0.001$. In order to correct

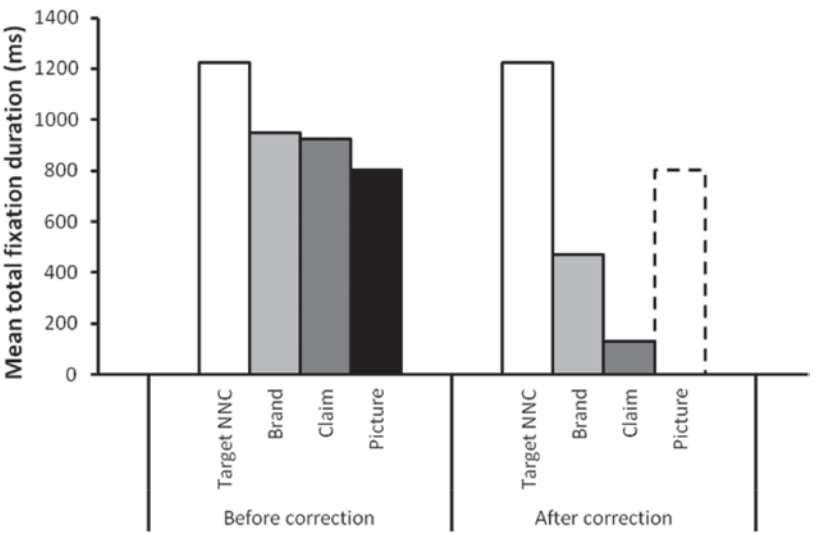


**Fig. 7:** Analysis of fixation times before and after correction for text length

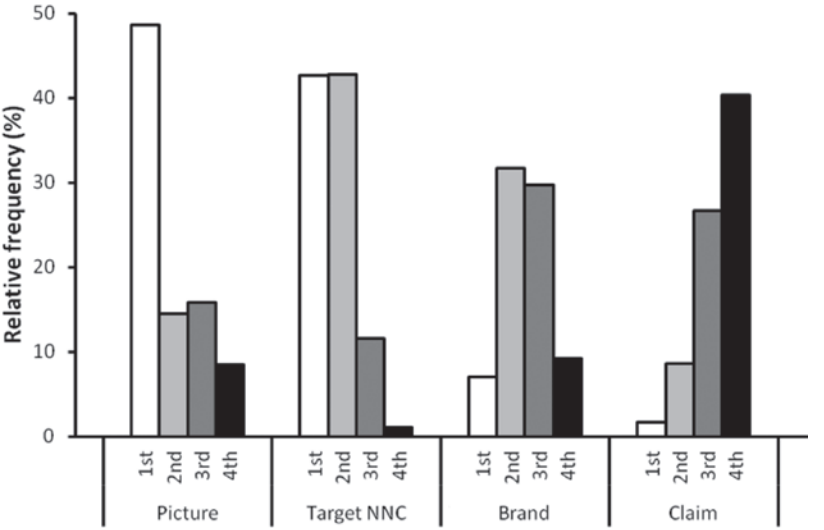


**Fig. 8:** Analysis of fixation order

for the effects of text length on processing times, we divided the mean fixation times for each AOI containing textual (verbal) information by the corresponding mean number of words: the target NNC contained the smallest quantity of text (one word by definition), followed by the brand (mean = 2.0 words), and the claim (mean = 7.2 words). This correction revealed that on average the participants spent 1,223 ms looking at the target NNC, 472 ms looking at the brand name (per word) and 129 ms looking at the claim (per word), *p*s < 0.0167 (Bonferroni correction for three comparisons: target NNC vs. brand name; target NNC vs. claim; brand name vs. claim).

For the analysis of fixation order (see Figure 8), we only considered the participants' "first trip round" the stimulus. With the four key AOIs, there were 64 possible fixation sequences; if all of the sequences were equally probable, then they should have occurred with a relative frequency of 1.6%.[14] For all 50 participants, the fixation sequences for all 24 trials were listed. The frequencies of the 64 different sequences were then calculated across participants. The most frequent fixation sequence (18.4%) was: *picture, target NNC, brand, claim*. There was a big drop to the next most frequent sequences, with the second and third sequences

**14** There are four possible sequences where only one of the AOIs is fixated (${}^4P_1$), 12 possible sequences where only two AOIs are fixated (${}^4P_2$), 24 possible sequences where only three AOIs are fixated (${}^4P_3$), and 24 possible sequences where all four AOIs are fixated (${}^4P_4$).

occurring with frequencies of 8.8% and 8.0% respectively. The fact that participants tended to fixate the picture first suggests the influence of stimulus-driven attention: the picture, as a large and purely visual stimulus, attracted attention automatically. Once the picture was fixated, however, the participant was free to follow their goal-driven examination of the stimulus.

The objective of the third analysis was to examine if the time spent on examining each AOI was influenced by whether the context was congruent or incongruent, i.e. either supporting or working against the pre-contextually preferred interpretation. An overall ANOVA revealed that the interaction between congruency and AOI was significant, $F(3, 144) = 13.259$, $p < 0.001$. Paired-sample $t$-tests revealed that in the incongruent conditions, the participants spent proportionally more time looking at the claim, $t(49) = 6.472$, $p < 0.001$, and proportionally less time looking at the picture, $t(49) = 4.127$, $p < 0.001$, in comparison with the congruent conditions. Corrections for text length confirmed these findings and suggested that, in the incongruent conditions compared with the congruent conditions, the participants also spent proportionally less time looking at the brand name, $t(49) = 2.996$, $p < 0.01$.

To summarise, analysis of eye movements confirmed that in the majority of trials (83.6%) participants fixated on at least three of the four AOIs, and thus not just on the target NNC as immediately required by the task. For the novel NNCs, this was likely a result of goal-driven attention, i.e. as a search for additional cues for interpreting an unfamiliar food name. In the case of conventional NNCs, however, the participants were expected to know the name and hence to be able to answer the question without help from the context. The reason they looked beyond this was probably stimulus-driven attention, i.e. caused by the immediate visual salience of something in the surroundings. In half of the trials (viz. those with incongruent contexts), any such information gained by the participant would have been deliberately constructed to point in a different direction than the pre-contextually preferred interpretation. This could potentially trigger a continued *goal-driven* search among the remaining elements to look for alternative explanations. In other words, the visual salience of a stimulus is likely to serve as an "icebreaker" for continued goal-driven search and may ultimately result in a contextually founded (re)interpretation of the NNC.

In the present setup, the principal "icebreaker" appears to be the picture which is fixated first in 48.6% of the trials (with the target NNC as the most likely second fixation) and second in 14.5% of the trials (with the target NNC as the most likely first fixation), see Figure 8. The tendency to fixate the target NNCs at an early stage can be explained by the placement of the fixation cross and the nature of the task. However, for the pictures this happens independently of the task and must be explained by inherent properties of the pictures which attract

stimulus-driven attention automatically. These include colour contrasts (e.g. Treisman and Gelade 1980), the presence of ecologically important objects such as human faces (e.g. Öhman et al. 2001), and, in the present case, also the relative size of the stimulus (e.g. Pieters and Wedel 2004). The fact that brand names tend to be fixated third, i.e. before the purely verbal claims, may likewise have to do with their relatively high degree of visual prominence (albeit lower than that of pictures) compared to plain text.

Another indicator of participants' visual interest in the respective elements is the total fixation time on the respective AOIs. In this respect, the NNC received proportionally more attention than the other elements containing verbal information (brand and claim), an effect which becomes even more pronounced if one corrects for text length (see Figure 7). A simple but plausible explanation is that the NNC is a natural place to rest one's eyes while replying to a question relating directly to the interpretation of that word, even after having read it once, i.e. as a sort of "reminder". The visual interest received by the pictures is also substantial considering that people can capture the "gist" of a visual scene in as little as 40–60 ms (Castelhano and Hendersen 2007; Cohen et al. 2010; Pieters and Wedel 2012). Any additional fixation time may be ascribed to the participants' continued examination of details in the pictures and/or the capability of these elements to (re)attract stimulus-driven attention automatically during the continued search. The longer fixation time for brands compared to purely verbal claims (even before corrections for text length) suggests that although they may appear as convenient "shortcuts" for additional information (e.g. Pieters and Warlop 1999), they also call for additional scrutinizing apart from simply reading them, once fixated. This is consistent with their character as elliptical and often not entirely transparent (in our case: fictitious) juxtapositions of word elements such as *FrigoFish* and *ClickChiq* rendered in non-standard colours and fonts.

It may seem paradoxical that a semantically explicit, transparent, and informative element like the verbal claim comes in last in terms of both fixation order and (when corrected for text length) fixation time. However, last does not necessarily mean least. The claim *is* fixated in the end in the vast majority of trials, and the fixation time must have been spent on reading it without dwelling on visual details (as with pictures and brand names) or the link between individual constituent words (as with the target NNCs and the creative word combinations in brand names). What the viewer gets in return is concise, explicit, and propositionally determined information that may offer important cues for meeting the overall task. An indication of this is that in the *incongruent* contexts the participants spent proportionally more time looking at the claim and proportionally less time looking at the picture and (after correcting for text length) the brand names. This suggests that when the task becomes more cognitively demanding viewers

will opt for an extra glance at the explicit verbal information rather than continuing with less conclusive picture-reading, whereas the latter may be preferred when everything else seems straightforward.

# 5 General discussion

Apart from shedding new light on the research questions (RQs) posed in Section 2 (as summarized in 3.5 and 4.5 above), the present research has implications for the central issues of linguistic theory introduced in 1.1 and for the more specific issues regarding online word and picture processing addressed in 2.1 and 2.2. Furthermore, it provides new leads for assessing the fairness and misleading potential of real-life food naming practices.

## 5.1 Linguistic implications: semantics and pragmatics, system and use

The distinction between semantics and pragmatics has been formulated in various ways in the literature (Levinson 1983; Sperber and Wilson 1995; Verschueren 1999; Itkonen 2008; Ariel 2010), some of which are more problematic than others. Cognitive linguists have been particularly critical toward a rigid separation between narrow ("dictionary") meanings and broad ("encyclopaedic") meanings (Langacker 1987; Geeraerts 2010). The distinction between "context-independent" and "context-dependent" lexical meaning has also come under attack (Geeraerts 1993; Allwood 2003; Zlatev 1997, 2003), as well as between "discrete" and "continuous" aspects of meaning (Langacker 2006). Some authors have even rejected the distinction between semantics and pragmatics altogether, by arguing that all linguistic meaning and structure are fluent and context-dependent (Hopper 1987; Jasperson et al. 1994; Kravchenko 2007). Still, it is both possible and useful to maintain the distinction, formulated as one of *conventional meaning* ("code") vs. *reasoning* ("inference"), without insisting that particular linguistic phenomena are 100% one or the other (Ariel 2010). Rather, phenomena like speech acts, metaphor, deixis, presuppositions etc. are best seen as products of the *interaction* of semantics and pragmatics, in varying proportions. Our findings imply that the same applies for noun-noun compounds, thus supporting, while at the same time elaborating, the claims of Zlatev et al. (2010).

On the face of it, the distinction between conventional and novel NNCs corresponds squarely to that of code vs. inference. The meaning of *Parma ham*

should be part of the common knowledge of English speakers and should be more or less invariant, while interpretations of *Copenhagen banana* will result from the combination of background knowledge, situational context, and "guesswork". Indeed, both of our experiments offered support for distinguishing between conventional and novel NNCs: the first were processed faster (shorter RTs) in both experiments and in Experiment 2 both in congruent and in incongruent contexts (cf. Figures 3 and 6). Furthermore, the resistance to overturning the (default) physical-origin interpretation by an incongruent context was stronger for the conventional than for the novel NNCs (cf. Figure 5). On the other hand, these effects where somewhat weaker than what could be predicted on a strict conventional vs. novel (= semantics vs. pragmatics) account. Furthermore, the ratings for the expected default meaning for novel NNCs were nearly identical with those of the "correct" meaning for conventional NNCs in Experiment 1 (Figure 2), showing lack of consensus among speakers on (in principle) conventional semantics. Examples such as *Parma-skinke* 'Parma ham' and *Madagascar-peber* 'Madagascar pepper' tended to be interpreted contrary to their normative meanings, and there was considerable individual variation for all examples. Furthermore, the addition of incongruent context in Experiment 2 led at least some participants to re-interpret conventional NNCs against their established meanings, even if to a lesser extent than for novel NNCs, similar to findings from previous research (Gagné et al. 2005).

The strongest argument against a binary semantics/pragmatics distinction with respect to noun-noun compounds, however, is the attested support for what we have referred to as the *default interpretation* for Place-Food NNCs, namely (physical) origin. Since this was the case for novel NNCs, it is apparently not a matter of convention ("code"). In a sense, it can be seen as a matter of inference since in the case of Place-Food NNCs, understanding <Place> as denoting the physical origin of <Food> is cognitively more straightforward than more indirect (metonymic) associations. Still, according to various proposals in cognitive-functional linguistics, there is a level of meaning between code and inference, namely entrenched usage patterns and cognitive schemas (Langacker 1987; Croft 2001; Bybee 2006), which is consistent with the following theoretical proposal:

> Thus, while our results are not consistent with a black-vs.-white distinction between semantics and pragmatics, they also speak against a position that would see the relation between them simply as a matter of a "cline" – of schematicity or entrenchment. Rather, we would advocate at least a three part distinction, as reflected in the NNCs: (1) conventional NNCs with established, normative, fully conventional, stored meanings; (2) indeterminate novel NNCs, whose interpretations are fully dependent on context; and between them, (3) the "grey area" of pre-contextually biased NNCs. In the case of the latter, higher level schemas

> such as the [Food-term] ORIGINATES IN [Place-name] schema (as default interpretation for the [N1: Place-name + N2: Food-term] construction) function . . . as a bias for the interpretation, interacting with the meanings of the constituent nouns, the background knowledge associated with them, and the sentential (or other) context in which the NNC appears. (Zlatev et al. 2010: 2810)

Ariel's (2010) proposal of a constant interplay between conventionality and inference is consistent with this proposal, and with the present findings.

Human sense-making is a highly flexible process which, in the case of NNC understanding, spans from retrieving pre-determined whole-word meanings (if available and not contradicted by context), over relying on default interpretations for the formation pattern as such, to abandoning them in preference to more tailor-made readings, based on cognitive principles such as metonymy, and additional cues provided by the context. Nevertheless, we believe that cognitive linguistics would benefit from a greater appreciation of the semantics/pragmatics (= code/inference) distinction, allowing, for example, cognitive metonymy to be seen on the side of inference, as a productive process of meaning extension and creative interpretation, but not as automatically activated in every use of conventional expressions. Thus, we may wish to qualify the following statement:

> In order to interpret Norwegian compounds where the second component denotes a person, language users have to perform a metonymy. If we imagine a language user who for some reason cannot handle metonymies, s/he would be at loss when facing compounds like *klossmajor* ['clumsy person', (lit. 'clumsy major')] and *driblefant* ['excessive dribbler' (lit. 'dribble-hobo')]. (Nesset 2010: 266)

It is rather the linguist that "would be at a loss" when facing the need to explain how such compounds became established in the first place, while ordinary speakers will make recourse to cognitive operations such as metonymy when inventing, or actively interpreting, novel compounds, but hardly when confronting familiar expressions such as *klossmajor, driblefant,* and *Hawaii pizza* in everyday use.

A similar logic applies to the "usage-based approach" to grammar and meaning, typically endorsed within cognitive-functional linguistics (Langacker 1987; Croft 2001; Bybee 2006). To the extent that this corresponds to an understanding of the dynamic relation between code/system/structure and inference/use/creativity, with the first undergoing constant (historical) change as a result of the latter, there is every reason to accept such a general perspective on language. On the other hand, some more radical approaches (e.g. Hopper 1987), which in

practice reject the first side of the dialectics as old-fashioned "structuralism" face problems. The importance of capturing the dynamics between system and use, while still maintaining a clear distinction between them, has been stressed by a number of language theorists over the past century (e.g. Marty 1908; Funke 1924; Jespersen 1942; Hörmann 1981; Coseriu 1985), then apparently "forgotten", only to be rediscovered again. The implication of the current study of NNCs is that these distinctions should be maintained.

## 5.2 Psycholinguistic implications: processing and context

Processing-oriented psycholinguistic research may likewise benefit from seeing the investigation of online NNC decoding and interpretation as part of a larger quest for understanding the nature and levels of linguistic meaning and lexicalization. In that light, it is equally important to ask why novel NNCs are constructed, why people make an effort to interpret them and what the final outcome would be if the novel compound and real-world referent are "successful" and become conventional.

Apart from such wider implications (to which we return in the final two paragraphs of this article) our findings also contribute new evidence to certain "local" debates within the processing-oriented literature. This includes the question of whether conventional NNCs are decomposed and interpreted anew at every encounter in running discourse as claimed by Gagné et al. (2005) but rejected by others. Within the limitations of our experimental paradigm, we failed to find support for such a hypothesis. In particular, the fact that conventional NNCs displayed lower RTs compared to novel NNCs even in incongruent contexts is hardly consistent with the idea that both types are routinely decomposed. Notably, this does not exclude the possibility for conventional compounds to be decomposed in some cases and by some speakers. Still, the significant difference in RTs between conventional and novel NNCs suggests that the latter procedure remains optional. So does the higher resistance to contextual influence of conventional NNCs compared to novel ones at large.

The work of Gagné and colleagues emerges from the so-called CARIN (Competition-Among-Relations-In-Nominals) psycholinguistic theory according to which novel and conventional compounds alike encode a number of relations which steadily compete with each other. More controversially, it is assumed that the established whole-word meaning of a conventional NNC simply comes down to one of these relations, namely the one that has received more contextual support than others in previous uses. In this variant of semi-compositional approaches (see 1.1), the set of possible relations is seen as pre-determined by

language structure while the choice depends on context. Without objecting to the role of context in fixing a meaning more permanently to an NNC or even inducing a new meaning that may gradually become conventional, it can be questioned if any such meanings can be identified with a simple paraphrase of the noun-noun relation. Just as a *butter cookie* is not just a 'cookie containing butter', a *Hawaii pizza* is not just a 'pizza inspired by Hawaii'. It must be made with pineapple (not papaya) and certain other ingredients (such as ham) to comply with the name.

In sum, there are grounds for seeing the whole-word meaning of established NNCs as qualitatively different from whatever interpretation of the noun-noun relation may be preferred by virtue of the hearer's familiarity with that whole-word meaning. Moreover, it would seem that it can be retrieved directly from semantic memory and allow the hearer to answer questions about, for example, the origin of the expected referent right away, without engaging in any further reflection on the noun-noun relation.[15]

Another processing issue to which our research contributes is the question of how words and pictures influence the processing of each other when encountered in combination. In a recent critical review of the existing experimental literature on the topic, Andersson (2012: 15–37) stresses the need for bringing the experimental settings in which the combined effect of words and pictures is studied closer to real-life situations and to integrate visual attention (what people actually look at) with the resultant semantic and communicative impact (i.e. how people make sense of what they see or read). The verbo-visual context of food labels offers an ecological setting suited for pursuing both of these goals in combination, while also retaining a degree of predictable schematicity and hence control. Key findings so far include: (a) the major role played by non-verbal (pictorial) elements in triggering semantic decoding and (re)interpretation processes in such cases where that would otherwise have seemed irrelevant (serving as "icebreakers"); and (b) the increasing role of propositionally determined verbal elements once the process becomes increasingly cognitively demanding, as in the incongruent conditions when the food name and the surrounding labelling elements appeared to contradict each other.

**15** In subsequent work (Ji et al. 2011; see also Gagné and Spalding 2006a), the original claim is modified and refined in some respects, allowing for a distinction between a "computed" meaning gained through decomposition/integration and a "retrieved" meaning which may even, under some conditions, conflict with it. This would seem to provide a viable basis for bridging between the seemingly incompatible lines of analysis presented here.

## 5.3 Real-world implications: potentially misleading food naming and labelling

This leads to the question of how our findings might contribute to assessments of the fairness and misleading potential of food naming and labelling practices. First of all, we showed that the widespread assumption among EU food authorities that a novel Place-Food NNC will tend to be interpreted in terms of physical origin indeed has empirical support. On the other hand, there are ways of preventing such an interpretation. This is valuable knowledge for fairness-minded food manufacturers and packaging designers who insist that their goal is to create attractive new products with catchy names, but without the intention to mislead.[16] After all, many existing names such as *Brussels sprouts* that do not conform to the default have found such equilibrium over time. As we have seen, some names can exclude an origin-oriented reading due to the semantics of the component nouns, and even trigger an alternative (metonymic) interpretation. However, as we have also seen, for other and probably most Place-Food NNCs the outcome depends on the labelling as a whole, not just the name. One essential lesson learned is that the viewer's distribution of visual attention and the joint potential of the labelling elements are equally important factors to consider when a re-interpretation of a pre-contextually expectable reading of the name is desired.

Today most empirical research into packaging design is marketing-oriented and focusses on attracting consumers' attention and predicting their purchase-decisions, rather than on reducing the risk of misleading them (e.g. Pieters and Warlop 1999; Gracia et al. 2009; Tonkin et al. 2011). By more systematically including state-of-the-art research into the semantics and processing of novel versus familiar words and the interface between verbal and visual communication, a case can be made for improving the fairness of product-to-consumer communication on empirical grounds.

Both theoretically and practically, a final question imposes itself. What comes with an interpretation of a Place-Food NNC in terms of either physical origin or something else? The full importance of the origin versus non-origin issue in food naming practices only becomes clear if we consider the additional expectations in terms of taste, mode of preparation, ingredients, nutrition value, quality, prestige, cultural symbolism, and so on, that such interpretations may trigger (Tregear and Gorton 2005; Rioninen et al. 2006). For novel food names, such ad-

**16** Of course, some food companies may be pursuing less noble goals and methods, not shying away from manipulating consumer behaviour by triggering undue inferences, in which cases the advantage is ultimately with the watchdogs of the market: the food authorities, consumer organizations, and, ultimately, consumers.

ditional expectations may be classified as situational pragmatic inferences which, if unjustified, may be corrected along the way. However, some of them are likely to transcend into a more permanent meaning that hearers will gradually acquire and come to connect with the novel name (and product).

Following Barsalou (1983, 1987, 2010), the categorical inferences made by the hearer during the first encounter(s) can be seen as elements of an *ad hoc* concept which may gradually evolve into a more elaborate and stable one. Exploring this dimension further would add an evolutionary dimension to the issues discussed and allow us to address, in operational terms, the possible encapsulation of both justified and unjustified beliefs in socially established linguistic norms (see also Barsalou, Wilson and Hasenkamp 2010). For additional experimentation along these lines, spontaneous descriptions of imagined NNC referents (Gill and Dubé 2007; Ares et al. 2008) would be a more appropriate methodology than rating tasks.

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