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The Cognitive Accessibility of Synaesthetic Metaphors

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Abstract

A (strongly) synaesthetic metaphor (e.g., *loud yellow*) is a metaphor that results from a combination of a modifier and a head, where both express perceptual qualities. Not all synaesthetic metaphors are cognitively equally accessible. In this paper the factors that enhance or reduce the cognitive accessibility of those metaphors are explored for the German language. The order of the sense modalities from which the modifiers and heads were taken turned out to be a significant factor for the accessibility of a metaphor, although earlier claims of a linear order of modalities could be disconfirmed. The frequency of the overall use of a modifier in the language and its morphological status as derived or not derived also turned out to be a significant factor, whereas the frequency of the head had no significant influence.

Introduction

The phenomenon of synaesthesia has gained increasing attention over the last ten years (Baron-Cohen & Harrison, 1997; Harrison, 2002; Cytowic, 2002). It has a neurological as well as a linguistic aspect. The neurological phenomenon describes the abnormal interaction of neural processes regarding different senses or modalities. According to varying estimates it occurs in about 1/20000 to 1/200 of the population (Cytowic, 1997; Baron-Cohen, Burt, Smith-Laittan, Harrison, & Bolton, 1996; Ramachandran & Hubbard, 2001). Subjects with synaesthesia in the neurological sense, e.g., have the phenomenal impression of color when they hear a particular tone ('C-sharp is blue'). Martino and Marks (2001) distinguish between strong and weak synaesthesia depending on whether the abnormal interaction is cross-sensory or simply cross-modal. According to them, subjects with the above mentioned sound-color interaction would exemplify strong synaesthesia, whereas subjects, who, e.g., have a particular color impression when they see a particular grapheme ('The 2 is yellow') would be cases of weak synaesthesia.

Ramachandran and Hubbard (2001) go even further and subsume also the abnormal connection of a phenomenal quality with an abstract object under the notion of synaesthesia. Some subjects, e.g., connect a visual impression with a day of the week ('Monday is red'). For Ramachandran and Hubbard those are cases of higher synaesthesia, while they count cross-sensory and cross-modal interactions as lower synaesthesia. According to them, the lower form is located in lower cortical regions, e.g., the fusiform gyrus, while the higher form is located in higher cortical regions like the angular gyrus.

The neurological phenomenon must be distinguished from synaesthesia as a phenomenon in natural languages. Here it typically occurs in the context of metaphors and is not restricted to a small proportion of the population. According to prominent theories of metaphors (Black, 1962; Lakoff & Johnson, 1980), any metaphor results from a mapping of some concept from a source domain (SD) onto a concept of some target domain (TD). In the metaphorical sentence

(1) The *road bows* down into the valley

a concept from the source domain of bodily motion (expressed by the verb *bow*) is mapped onto a concept from some geographical target domain (expressed by the noun *road*). The reader is now forced to transform the source concept in order to match it to the target concept. Thus the metaphorical interpretation of the composed expression results.

In the case of synaesthetic metaphors, the source domain (SD) – in adjective-noun constructions typically the domain of the modifier – is restricted to concepts of perception, which make up the perceptual domain (PD). A rough, but natural classification of the perceptual domain can be made along the five senses: color, sound, touch, smell, and taste. This leads to a classification of the following examples:

(2) The old woman had an *open heart*

(3) The rich man had a *cold heart*

(4) The stone statue had a *cold smell*

Example (2) is a metaphor, but not a synaesthetic one because the modifier does not come from a perceptional domain. The second and the third case pass the definition and, therefore, are synaesthetic metaphors. They are, however, quite different with respect to their target domain. In (4) the target domain and the source domain both are from PD, whereas in (3) only the source domain is. We, therefore, call the former a *strongly synaesthetic metaphor* and the latter a *weakly synaesthetic metaphor*:

Definition (Synaesthetic Metaphor) *A metaphor is synaesthetic if and only if its source domain is perceptual. It is only weakly synaesthetic if its target is not also* *perceptual, and strongly synaesthetic if its target domain, too, is perceptual.*

This definition parallels the distinctions in the neurological sphere drawn by Martino and Marks, on the one side, and Ramachandran and Hubbard, on the other side. For the rest of this paper, our interests lie exclusively on strongly synaesthetic metaphors.

It has not yet been fully explained how synaesthetic metaphors can be understood by speakers and hearers at all. This has to do with the striking fact that synaesthetic metaphors, on the one hand, form a highly productive class of expressions, but on the other hand, they seem to be semantically largely non-compositional; or at least, the mechanism of semantic composition lies entirely in the dark (For the notion of compositionality see Fodor & Lepore, 2002, and Werning, 2004). This contradicts the widely held expectation that all cases of linguistic productivity root in semantic compositionality (for other counterexamples see Werning, 2005a, though). Moreover: whereas semantic explanations of ordinary metaphors usually recur to a certain semantic structure of the components (Löbner, 2002), the sensual qualities expressed by the components of synaesthetic metaphors are apparently semantically primitive or at least very little structured.

It also remains open if the neurological phenomenon and the linguistic phenomenon of synaesthesia have common or, at least, related grounds, or if they are completely distinct phenomena. Ramachandran and Hubbard even see an important role for synaesthesia in the evolution of language and argue that "[the] solution to the riddle of language origins comes from synaesthesia" (Ramachandran & Hubbard, 2001, p. 19). Any corroborated link of the two phenomena promises to be a substantial contribution to the exploration of the neural correlate of semantic composition (Hurford, 2003; Werning, 2005b).

The central question for the empirical study presented in this paper was why some synaesthetic metaphors are cognitively more accessible than others. Although, it is very obvious that there are large differences in the cognitive accessibility of synaesthetic metaphors, the empirical data sofar have been relatively poor. What are the relevant factors that may reduce or enhance the accessibility of a synaesthetic metaphor?

Ullmann (1967), in a very early study on synaesthetic metaphors, proposes a certain hierarchy of lower and higher perceptual modalities (see Fig. 1). He claims that qualities of lower senses (on the left of the hierarchy) should preferentially occur in the source domain, while qualities of higher senses (on the right of the hierarchy) should be preferred in the target domain. His thesis of *directionality* thus entails that a metaphor with a source domain lower in the hierarchy of sense modalities than the target domain (e.g., *cold blue*, touch – color) should tend to be cognitively more accessible than a metaphor with the reverse direction of domains (*blue cold*, color – touch).[1]

In succession to Ullmann, Williams (1976) makes a more differentiated claim of directionality, in which a similar order of sense modalities is proposed, but the order is no longer linear. Williams, e.g., cites *bright sounds* (color – sound) as an example for an accessible metaphor that does not conform with Ullmann's linear order of sense modalities. Instead, Williams proposes a somewhat more complex order (see Fig. 2).

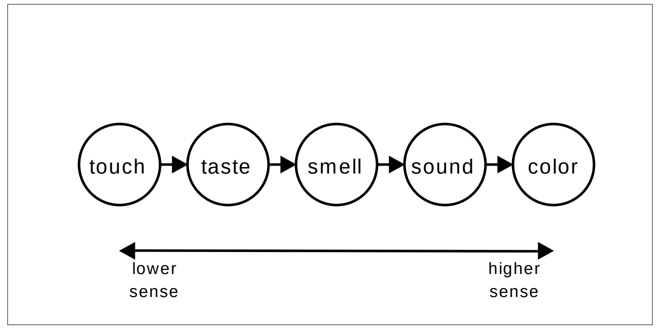

Figure 1: Directionality and the hierarchy of the senses according to Ullmann (1967).

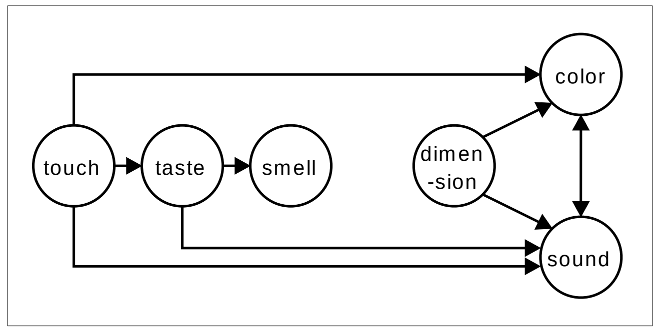

Figure 2: Directionalities according to Williams (1976, p. 463).

Recently, Yu (2003) highlights cross-linguistic differences, when he makes different directionality claims for different languages (English as compared to Chinese). In the light of those directionality claims, Shen argues that "poetic synesthesia systematically prefers to map terms of lower distinctiveness onto terms of higher distinctiveness, rather than *vice versa*" (Shen, 1997, p. 48). His argument grounds on an analysis of several lyric corpora and gains support from an empirical pilot study. He argues that, first, the directness of contact between a sense and what is perceived and, second, the existence of a special sense organ increases the accessibility of a sense modality. Accordingly, sense modalities with wider distance between the perceiver and the perceived (color and sound as opposed to smell and taste) and a special sense organ (ear, nose, tongue and eyes) are of higher distinctiveness and thus at one pole in the order of directionality.

Given that some version of a directionality claim is

[1] Ullmann (1967, p. 287) cites i.a. *warm color* and *to sweeten the sounds* as accessible metaphors supporting his directionality claim.

true for a certain language, the choice of source and target domain should significantly influence the accessibility of a synaesthetic metaphor. But there could also be other factors: the overall frequency of words used as modifiers or heads, the morphology of the words, as well as personal factors of the interpreter, like age, gender, and mother tongue. Our experiment performed for the German language was designed to isolate the factors that correlate with the cognitive accessibility of synaesthetic metaphors and to explicitly explore the role of directionality.

Experiment

Method

Subjects 107 students from Düsseldorf at an age from 19 to 70 (mean 27.73) participated in the study. 65 of them were female and 42 were male. All but 15 were native speakers, the others still were competent in German.

Design In German there are highly productive morphological rules to generate nouns from adjectives. For example *süß* ('sweet') – *die Süße* ('sweetness') for the modality of taste and *dunkel* ('dark') – *die Dunkelheit* (darkness) in the modality of color. From the very limited number of German lexicalized adjective-noun pairs that express the same sensual qualities a nearly exhaustive list of 57 were chosen. The Cartesian product of the list of adjectives with the list of nouns generated a set of strongly synaesthetic metaphors, e.g., *süße Dunkelheit* ('sweet darkness') and *dunkle Süße* ('dark sweetness'). From this set an equal quantity was selected for each of the 20 possible SD-TD directions.

It was taken care that for each metaphor with a certain succession of source and target domain ($X_{SD} - Y_{TD}$) the complementary metaphor ($Y_{SD} - X_{TD}$) was adopted. To accomplish a broad range of metaphors, we randomly divided the subjects into five groups with an average size of 21.4 (min. 18, max. 24). Each group was presented a list of 34 synaesthetic metaphors. So, altogether 170 different metaphors were tested.

Subjects were asked to assess the intuitive accessibility of each metaphor. Possible values were -1 for 'not accessible' and $+1$ for 'accessible'. Gender, age, and mother tongue of the subjects were also recorded.

Corpus Analysis To consider additional variables that could effect the subjects' answers, we analyzed the frequencies of the adopted adjectives and nouns. The frequencies were determined from the German version of the CELEX corpus (Baayen, Piepenbrock, & Gulikers, 1995). This corpus consists of about six million words taken from written and spoken sources representative for contemporary German.

Morphological Analysis As a further variable we considered the morphological derivation status of the modifier adjectives. Some adjectives were genuine adjectives, e.g., *warm* ('warm'), while others were morphological derived from verbs or nouns by productive morphological rules, e.g., *riechen* – *riechend* ('smell' – 'smelling'), *Aroma* – *aromatisch* ('aroma' – 'aromatic').

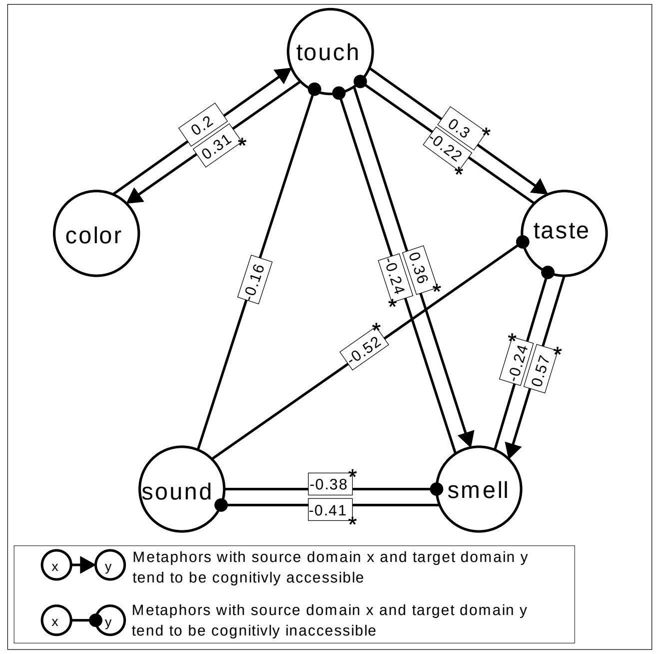

Figure 3: Significant influences of directionality on accessibility. The numbers in boxes show the differences to the expected mean value (0). Only significant results are displayed ($p < 0.05$). Highly significant results are marked with '*'($p < 0.01$).

Results

Gender, age, and mother tongue did not significantly correlate with the judgements of accessibility. However, directionality did. A quantitative analysis for all 20 directions is shown in Fig. 4.

The null hypothesis that there would be no directionality effects on the accessibility of a metaphor would lead to the expectation of an equipartition. Since we assigned the value $+1$ to 'accessible' and -1 to 'not accessible', a mean value of 0 should be expected for the null hypothesis. A t-test was used to calculate significant deviations ($p < 0.05$) from the expected mean value. All significant deviations from the expected mean accessibility for the directions are shown in the diagram of Fig. 3. Directions with non-significant deviations from the null hypothesis are not shown. A positive value indicates a significant enhancement for the respective SD-TD direction. I.e., metaphors with the respective SD-TD direction tend to be cognitively more accessible than expected by the null hypothesis. A negative value indicates a significant impediment for this direction, i.e., metaphors with a thus annotated SD-TD direction tend to be cognitively less accessible than expected by the null hypothesis.

To analyze the influence of the remaining variables, a Pearson-correlation analysis was performed. It turned out that the frequency of the head of a metaphor is not significantly correlated with the accessibility of the metaphor. However, the frequency of the modifier of a metaphor is highly significantly correlated (correlation coefficient 0.134, $p < 0.01$) with an enhancement of the

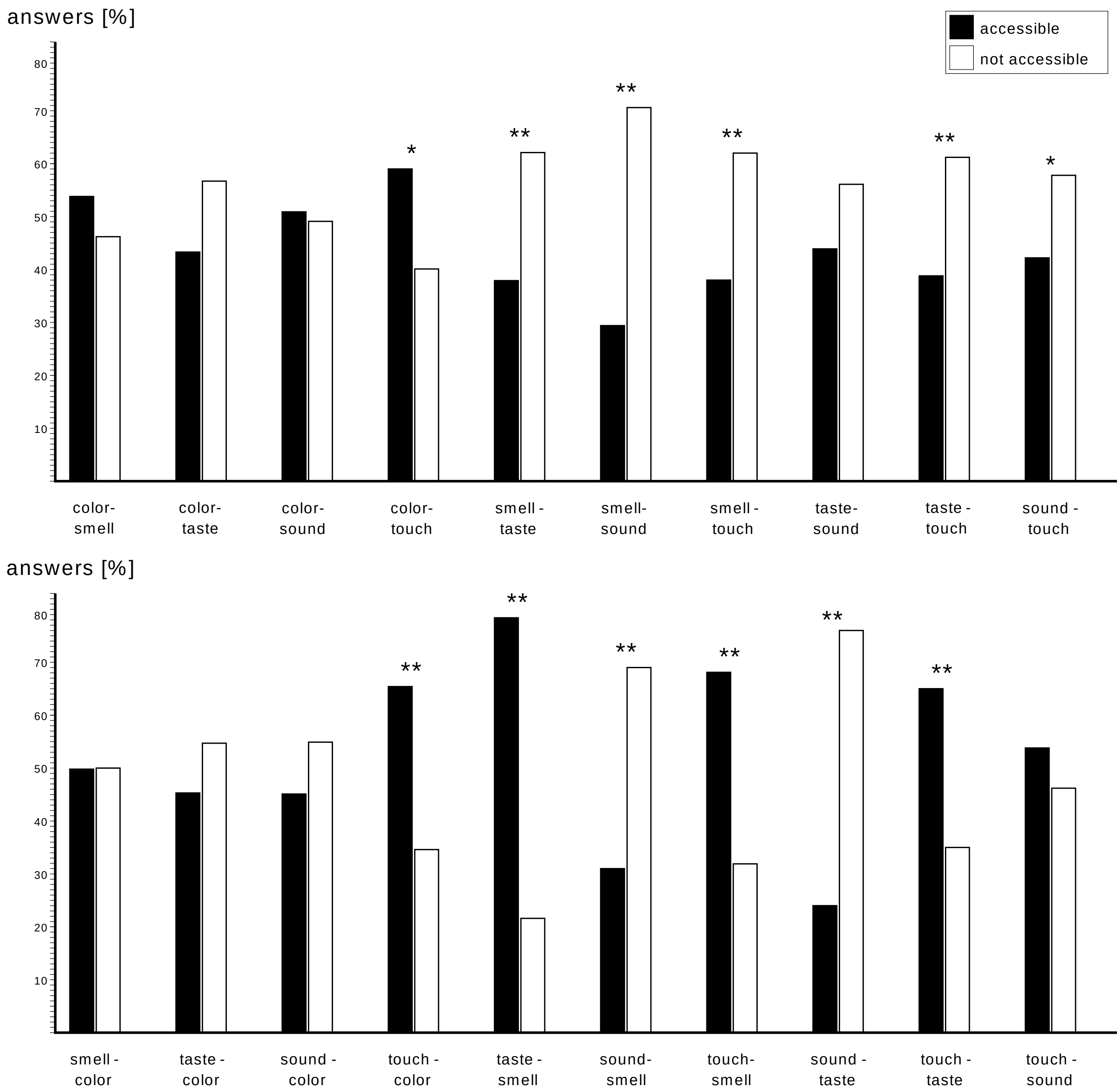

Figure 4: Proportion of accessibility as a function of the SD-TD direction. The diagram shows the proportion of metaphors assessed ‘accessible’ or ‘not accessible’ for each direction. Significant results ($p < 0.05$) are marked with ‘*’, highly significant ones with ‘**’ ($p < 0.01$). Reverse directions are shown one upon the other.

metaphor’s cognitive accessibility. In Fig. 5 the mean frequencies of modifiers for the different modalities are drawn.

The derivation status of modifier adjectives turned out to be highly significantly correlated with cognitive accessibility, too (correlation coefficient -0.158, $p < 0.01$). In general derived adjectives tend to reduce the accessibility of a metaphor as opposed to non-derived adjectives. Fig. 6 descriptively represents the average accessibility of a metaphor as a function of the derivation status of the modifier for each modality.

Discussion

Directionality seems to be one of three factors that significantly correlate with the cognitive accessibility of synaesthetic metaphors. Some version of a direction-

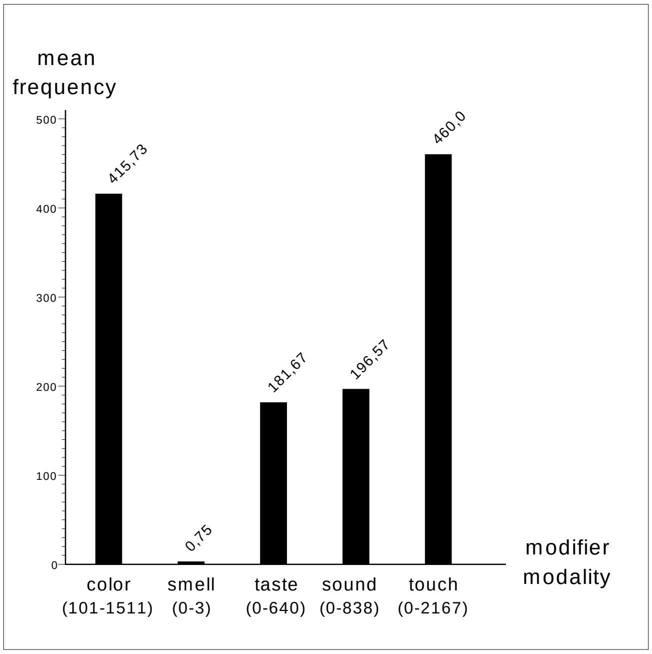

Figure 5: Frequencies of modifiers for each modality. The numbers in brackets show the range of variation.

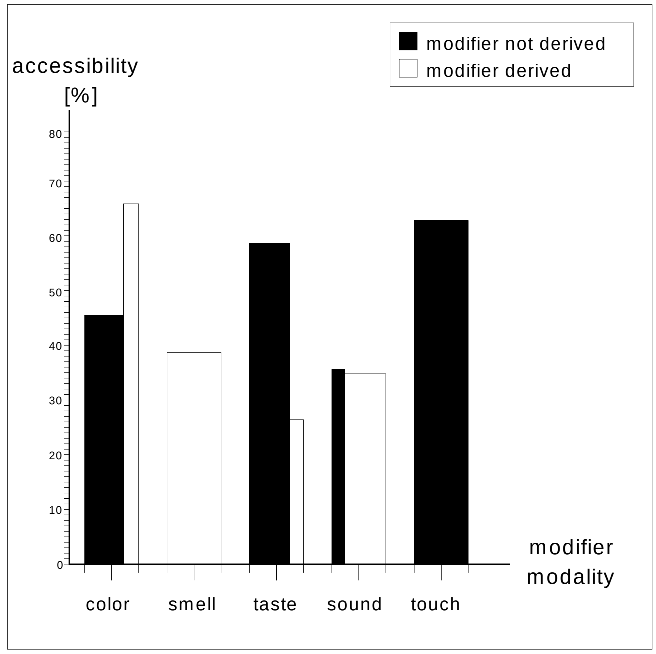

Figure 6: Total degree of the accessibility of metaphors with morphologically derived/not derived adjectives. The bar width expresses the proportion of derived and not derived adjectives within each modality.

ality claim, which is more akin to Williams than to Ullmann, could be confirmed. The order of sense modalities is not simply linear (as claimed by Ullmann), but also not even transitive (as still held by Williams). The order of modalities turned out to be instead as complex as shown in Fig. 7. No mapping allowed by Williams is now forbidden, however, additional mappings are now allowed. Contrary to Williams, the direction SD color to TD touch enhances cognitive accessibility. The direction SD color to TD smell as well as the reverse direction is no longer forbidden. For, no significant reduction of accessibility could be observed. The same holds for both directions between color and taste. Unlike Williams, we cannot predict that both directions between color and sound enhance accessibility. For, neither significant enhancement nor significant reduction could be observed here.

As for Williams and even Ullmann, the modality touch is the best source domain. The only not significantly enhancing direction from SD touch is that to TD sound. The modalities smell and sound seem to be relatively bad source domains. For, the only non-reducing direction is that to color.

Aside from directionality further variables seem to influence the accessibility of synaesthetic metaphors, namely frequency and morphological derivation. The three factors might not be independent from each other, though. For one, there seems to be a striking dependency between the frequency and the modality of a modifier. We can not decide, yet, whether this particular distribution of high and low modifier frequencies over the modalities is restricted to German and other European languages, or whether it is linguistically universal.

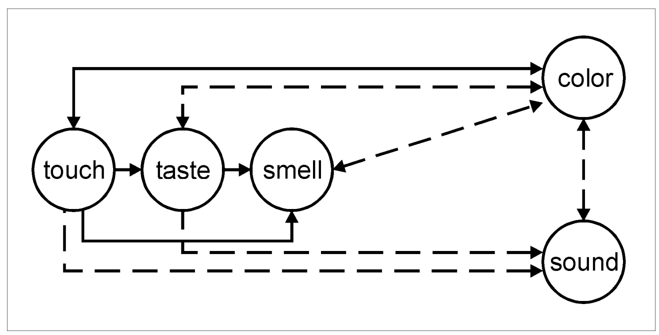

Figure 7: Directionalities according to our data. Black arrows show significant enhancement, while dotted lines represent not significantly impeded directions.

Another important observation is that the morphological status of modifiers is not equally distributed over all modalities. Whereas the great majority of modifiers in the modality smell are derived, only a small minority of modifiers in the modality of touch are non-genuine adjectives. Again, it would be interesting to explore if this is a universal linguistic fact.

Given these dependencies, it can not be ruled out *a priori* that the differences in accessibility of a metaphor might be explained solely on the basis of frequency and morphological status of the modifier. Another hypothesis would be that the unequal distribution of frequency and morphological status over the modalities is not accidental, but has a deeper explanation in the neurology of the senses and the organization of related cortical regions. A cross-linguistic comparison as well as further neuro-scientific research might help to settle this point. In this context, it would be especially interesting to draw a parallel between the linguistic and the neuronal phenomenon of synaesthesia. It has to be explained why certain SD-TD directions lead to more accessible metaphors than others.

Moreover, there seems to be evidence for the existence of factors not yet systematically analyzed. To exemplify this point, one may take into consideration the striking difference in accessibility between the two metaphors:

(5) *gelbe Ruhe* ('yellow silence')

(6) *blasser Klang* ('pale sound')

All subjects assessed the first metaphor 'not accessible', but for 93% the second metaphor was accessible. This is so despite the fact that their modifiers are both morphologically not derived and the metaphors share the same directionality (color – sound). Moreover, the frequency of the adjective *gelb* (203) even exceeds the frequency of the adjective *blass* (101). One hypothesis might be that the metaphor *blasser Klang* might have been overused and almost became a dead metaphor, which has lost much of its figurative value. However, why is it that this particular metaphor was apt to be used frequently? One would expect that only metaphors that are cognitively accessible in the first place have the potential to become common knowledge.

It should also be mentioned that, even though a certain directionality may generally reduce accessibility, single cases may behave differently. The metaphor

(7) *stiller Geruch* ('silent smell')

was, e.g., cognitively accessible for about 60% of our subjects, although the SD-TD direction (sound – smell) significantly reduces accessibility in general. In light of those yet unaccounted cases and given the effects described in this paper, further research seems to be well motivated.

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