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Abstract

Linguistic iconicity, the intricate relationship between the form of a language signal and its meaning, has been recognized as a crucial element in language acquisition (Sehyr & Emmorey, 2019; Ortega, 2017). Sign languages, such as Austrian Sign Language (ÖGS), present a unique opportunity for investigating iconicity due to their inherently visual nature and the higher frequency of iconic forms compared to spoken languages (Perniss & Vigliocco, 2014). However, until now, relatively little is known about the degree of iconicity (how iconic the form is perceived) and to what extent aspects such as iconicity strategy (acting, drawing, representing, personification), semantic category (action with object, action without object, manipulable object, unmanipulable object, and animate entity), or lexical class influence the degree of iconicity. This study addresses the underexplored aspects of iconicity in ÖGS by employing a twofold approach. Firstly, an initial iconicity rating is conducted for a diverse set of 328 ÖGS signs, utilizing evaluations from hearing non-signers. Secondly, the study investigates the potential influence of various factors—such as the strategy of iconicity, semantic category, and lexical class—on the degree of iconicity in ÖGS. Data analysis showed verbs receive higher iconicity ratings than nouns. Moreover, signs employing the acting strategy received higher iconicity ratings compared to those utilizing representing, drawing, or personification strategies. Further exploration into semantic categories demonstrates that actions with objects achieve the highest iconicity ratings. This study contributes to the understanding of iconicity in ÖGS by providing the first iconicity rating for a substantial number of signs and simultaneously investigating the interplay between the degree of iconicity and factors, such as strategies of iconicity, semantic category, and lexical class.

Linguistische Ikonizität, die komplexe Beziehung zwischen der Form eines sprachlichen Signals und seiner Bedeutung, wurde als entscheidendes Element im Spracherwerb anerkannt (Sehyr & Emmorey, 2019; Ortega, 2017). Gebärdensprachen wie die Österreichische Gebärdensprache (ÖGS) bieten aufgrund ihrer visuellen Natur und der höheren Häufigkeit von ikonischen Formen im Vergleich zu gesprochenen Sprachen eine einzigartige Gelegenheit zur Erforschung von Ikonizität (Perniss & Vigliocco, 2014). Bislang ist jedoch relativ wenig darüber bekannt, inwieweit Aspekte wie die Ikonizitätsstrategie (actind, drawing, representing, personification), semantische Kategorie (Aktion mit Objekt, Aktion ohne Objekt, manipulierbares Objekt, nicht manipulierbares Objekt und Lebewesen) oder lexikalische Klasse den Grad der Ikonizität (wie ikonisch wird die Form wahrgenommen) beeinflussen. Diese

Studie widmet sich den wenig erforschten Aspekten der Ikonizität in der ÖGS mit einem zweiseitigen Ziel. Einerseits wird eine erste Ikonizitätsbewertung für 328 ÖGS Gebärden durchgeführt, auf Basis von Bewertungen durch hörende Personen ohne Gebärdensprachkenntnisse. Andererseits untersucht die Studie den möglichen Einfluss verschiedener Faktoren, wie der Ikonizitätsstrategie, semantischer Kategorie und lexikalischer Klasse, auf den Grad der Ikonizität in der ÖGS. Die Ergebnisse zeigen, dass Verben höhere Ikonizitätsbewertungen als Nomen erhalten. Darüber hinaus weisen Gebärden, die zur acting Strategie gehören, höhere Ikonizitätsbewertungen auf als solche, die die drawing, representing oder personification Strategien nutzen. Eine weitere Untersuchung der semantischen Kategorien zeigt, dass Aktionen mit Objekten die höchsten Ikonizitätsbewertungen erhalten. Diese Studie trägt zum Verständnis der Ikonizität in ÖGS bei, indem sie die erste Ikonizitätsbewertung für eine beträchtliche Anzahl von Gebärden bereitstellt und gleichzeitig das Zusammenspiel zwischen dem Grad der Ikonizität und Faktoren wie Ikonizitätsstrategie, semantischer Kategorie und lexikalischer Klasse untersucht.

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1 Introduction

One crucial aspect of language that has captivated the attention of researchers and linguists for years is *iconicity*, the concept that linguistic items may resemble their meanings (Perniss, 2010; Ortega, 2017; Perniss, 2018). Over the last years extensive research has examined the relation between iconicity and language (for a review see Perniss et al., 2010; Ortega et al., 2017; Dingemanse et al., 2015) and it is nowadays widely accepted that iconicity facilitates language acquisition and predicts early vocabulary in infants (e.g., Caselli et al., 2020; Ortega, 2017). To be more precise, Caselli et al. (2020) demonstrated that the degree of iconicity predicts early vocabulary development in American Sign language (ASL).

To assess the generalizability of these findings across all languages, both spoken and signed, it is important to have access to databases containing detailed information about the properties of linguistic elements. They play a pivotal role in the systematic investigation of language, aiding in controlling variables that affect language processing (Caselli et al., 2017). While extensive lexical databases for spoken languages already exist, providing insights into aspects such as frequency, neighborhood density, and morphological structure (e.g., the English Lexicon Project by Balota et al., 2007) the situation is less promising for sign languages, where resources for research are limited (Caselli et al., 2017).

Sign languages in general offer expanded opportunities to explore iconicity compared to spoken languages as it is assumed that sign languages show a higher percentage of iconic forms (Perniss & Vigliocco, 2014). Sign languages are expressed visually and hence provide the possibility to depict perceptual aspects or visual features of the meaning (such as form, shape or actions that are associated with the referent) (Novogrodsky & Meir, 2020).

Previous endeavours aimed at developing iconicity ratings in sign languages include the work of Vinson et al. (2008) on British Sign Language (BSL), the work of Trettenbrein et al. (2021) on German Sign Language (DGS) and the creation of ASL-LEX, a substantial database focusing on ASL, by Caselli et al. (2017). Yet, to the best of my knowledge, for Austrian Sign Language (ÖGS), a significant gap remains, as no iconicity rating has been conducted. Therefore, this master's thesis aims to bridge this void by providing the first iconicity rating for 328 ÖGS signs. The collection of iconicity ratings in ÖGS sets the stage for future research to delve deeper into sign language processing and acquisition in ÖGS and sign languages in general. Beyond the iconicity ratings, this thesis seeks to unravel the factors influencing the degree of iconicity in ÖGS signs, exploring aspects such as lexical class, semantic

category, and strategy of iconicity. By shedding light on these facets, the research presented herein aims to advance our understanding of the aspects influencing iconicity within sign languages, offering a foundation for future investigations into the broader landscape of linguistic iconicity. In doing so, this master's thesis emerges as a pivotal contribution to the ever-evolving field of language research, with implications reaching far beyond the realms of sign languages, enriching our understanding of languages in general.

The master's thesis is structured as follows: Chapter 2 provides a comprehensive overview of sign language structures in general, with a specific focus on Austrian Sign Language (ÖGS). It delves into its origins, dialects, and structural aspects, providing insights into the current state of knowledge. In Chapter 3, the concept of iconicity will be closer examined, endeavoring to formulate a precise definition by examining commonalities across various approaches. Moving on to Chapter 4, both potentially universal and modality-specific methods for the expression of iconicity will be introduced. Particular attention is dedicated to possible ways sign languages can establish a connection between form and meaning. Chapter 5 delves into the role of iconicity in language acquisition. The following Chapter 6 summarizes the current state of knowledge about aspects that influence the degree of iconicity. Chapter 7, in turn, outlines the details of the experimental design employed in this master's thesis. This chapter covers the rationale behind conducting this research, the hypotheses to be tested, stimulus selection, the research procedure, and data analysis methods. Chapter 8 summarizes the findings of these analyses. In Chapter 9, a review and discussion of the primary findings from this master's thesis is provided, highlighting its limitations, and offering directions for future research. Finally, Chapter 10 presents a brief conclusion, bringing this master's thesis to a close.

PART ONE: Theoretical Framework

2 Sign Languages and Austrian Sign Language (ÖGS)

This section provides a brief description of the characteristics and the structure of sign language in general. The second section will deal with ÖGS in specific and introduce the main characteristics of this sign language.

2.1 General Overview over Sign Languages

Sign languages are fully fletched languages and, unlike spoken languages, belong to the so-called visual-spatial languages. This means sign languages are expressed by using one's hands, face, or other parts of the body. A typical sign is articulated on the body or close to it in the three-dimensional space. Sign languages show their own grammar and lexicon and are not derived from the spoken language used by the hearing community in the same country (Boyes Braem, 1995).

Sign languages should not be conflated with other gestural communication systems like manually coded languages[1] (Skant et al., 2002) or pantomime. The distinction between signs and pantomimes lies in the fact that signs are confined to a limited signing space in front of the head and upper body, while pantomimes encompass the entire body and the surrounding space (Baker, 2016). Furthermore, pantomimes are communicative gestures with symbolic content, but they lack the hierarchical linguistic structures found in signs (Krentz & Corina, 2008). The same structural levels (phonology, morphology, lexicon, semantics and syntax) that are found in spoken languages can be identified for sign language as well. On the level of phonology, minimal features combine to produce a meaningful linguistic item (Ortega, 2017). The minimal features of a typical sign are so-called phonemes or manual parameters and encompass *handshape, movement, location* and *orientation* (Baker et al., 2016).

Handshape: The signers' hands can form various handshapes, however, only a limited set of possible hand configurations is used in sign languages. This set of handshapes differs from one sign

[1] Manually coded languages usually follow the structure of the (written) oral language and use signs parallel to spoken language. Manually coded languages can be further distinguished based on whether only important words are depicted through a sign or if signs are used throughout the whole conversation, representing (almost) every word through a sign. (Leonhardt & Kaul, 2023)

language to another, meaning that distinct sign languages employ unique sets of handshapes. Generally, each sign language employs around 20 to 30 different handshapes, with approximately 5 to 10 handshapes being common across all known sign languages and typically among the first learned by infants (Skant et al., 2002, p. 18).

Furthermore, signs can be categorized as either one-handed or two-handed signs. In the case of one-handed signs, as the name implies, they are produced with a single hand, specifically the dominant hand. On the other hand, two-handed signs can be further subcategorized into symmetrical and asymmetrical signs. Symmetrical signs involve both arms using the same handshape and synchronized movement with the left hand mirroring the actions of the right hand. Asymmetrical signs, in contrast, employ two distinct handshapes, with the non-dominant hand serving as the location for the dominant hands's movement. Typically, the dominant hand takes on a more active role, while the non-dominant hand plays a relatively passive role in these signs (Skant et al., 2002).

Orientation: This aspect refers to the direction in which the palm of the hand is facing (Baker, 2016). The orientation of the palm is crucial for the meaning of a sign, as the sign's meaning changes depending on whether the palm faces downward, upward, or sideways. In some cases, signs may only differ in this orientation parameter (Skant et al., 2002).

Location: Signs are typically articulated in the three-dimensional space surrounding the signer's upper body, often referred to as the signing space. This signing space encompasses various locations, such as the forehead, nose, cheek, mouth, ear, neck, chin, shoulder, upper torso, underarm, or stomach. In the case of asymmetrical signs, the nondominant hand can also serve as a place of articulation. Similar to handshape and orientation, the location component alone can be the sole parameter distinguishing the meanings of two signs (Skant et al., 2002).

Movement: This parameter pertains to the motion of the sign within the signing space. It describes the direction of movement, the type of movement, the frequency of movement (single or repeated), whether the movement is symmetrical (in the case of two-handed signs), the size and speed of the movement, and the intensity of the movement (Skant et al., 2002).

These four phonemes or manual parameters serve a function analogous to that of phonemes in spoken languages. The key distinction from spoken languages lies in the fact that these parameters or

minimal features are combined simultaneously, whereas vowels and consonants in speech are produced sequentially. The meaning of a sign is derived exclusively from the concurrent combination of these four elements; any alteration in one of these parameters results in a corresponding change in the meaning of the sign (Baker, 2016). This can be best compared to the fact that the replacement of a phoneme in spoken languages changes meaning as well like in /hat/ and /cat/ (Ortega, 2017). Signs that only differ in one parameter are called minimal pairs (Skant et al., 2002).

In addition to that, signs are often produced in combination with non-manual markers such as head and body postures, eye gaze, facial expression and mouth movements (Skant et al., 2002). Facial expression describes actions such as frowning, raised or contracted eyebrows or wrinkled nose (Skant et al., 2002). Facial expression, and the movement of eyebrows, nose and eyes can be essential for grammar (Baker, 2016). Raised eyebrows can function as rising intonation and are used to mark questions in ASL. The absence of such a marker in questions can cause them to be incomprehensible (Wilbourn & Casasola, 2007). Regarding mouth movements, one can further distinguish between mouthings and mouth gestures. Mouth gestures on the one side describe mouth or lip movements that do not show any relation to the spoken word form but are also produced simultaneously to the sign. In British Sign Language (BSL) and Sign Language of the Netherlands (NGT), the sign BE-PRESENT is accompanied by the mouth movement [sh] (the mouth movement of producing the sound *sh*) that shows no connection to the spoken English or Dutch word form (Baker, 2016). Mouthings on the other side describe the simultaneous mouth movement that is based on the spelling of the respective spoken word form. This type of mouth movement resembles the lip movement of people when spelling out the corresponding spoken word form. Nevertheless, mouthings should not be confused with the mere voiceless articulation of words, as they exhibit several distinctions. For instance, mouthings frequently replicate the pronunciation of the base or stem form of words rather than their inflected forms. Furthermore, mouthings typically mirror only the segments of spoken words where lip movements are visibly prominent. For instance, for the sign BUCH (book) from German Sign Language (DGS) only the syllable -bu (spelled as [bu]) is used as mouthing since the pronunciation is visible as lip movement whereas the pronunciation of -ch (spelled as [x]) cannot be seen on the lips. The function of mouthings can be to distinguish between signs that use the same manual parameters (Boyes Braem, 1995).

2.2 Austrian Sign Language (ÖGS)

This section provides an overview of the existing knowledge regarding ÖGS. It begins by offering general insights into ÖGS, followed by a focused examination of its structural aspects in the latter part of this section.

2.2.1 *Overview*

The language the Deaf Community in Austria is using is called Österreichische Gebärdensprache (ÖGS). ÖGS (and its dialectal variations) is used across Austria by approximately 8000-10 000 people but numbers are increasing as the language gets more and more popular especially among hearing people. Since September 1st, 2005, ÖGS has been officially recognized as a minority language in Austria. It is important to emphasize that there is no standardized form of ÖGS. The research field around ÖGS and its dialects is very young resulting in many aspects that remain unexplored and undocumented yet (Schalber, 2006).

2.2.2 *Origin*

The origin and development of ÖGS remain relatively obscure, but ÖGS might have played an important role at the beginning of the education of the Deaf community in Austria because in 1779, Emperor Joseph II established the k.u.k. Taubstummeninstitut as the first Deaf institute in the Austro-Hungarian Empire, drawing inspiration from the Deaf school in Paris founded by Abbé de l'Épée. Given that the sole Deaf school of the Austro-Hungarian Empire was situated in Vienna, many children from various regions of the Empire were sent to the present-day capital of Austria for their education and learned the sign language that was used in Vienna. This circumstance might explain the similarities between ÖGS, particularly in terms of lexicon and the manual alphabet, and sign languages used in countries that were part of the former Habsburgian monarchy, such as Croatian Sign Language and the dialectal version of Italian Sign Language employed in Trieste. (Schalber, 2006).

2.2.3 *ÖGS and its Dialects*

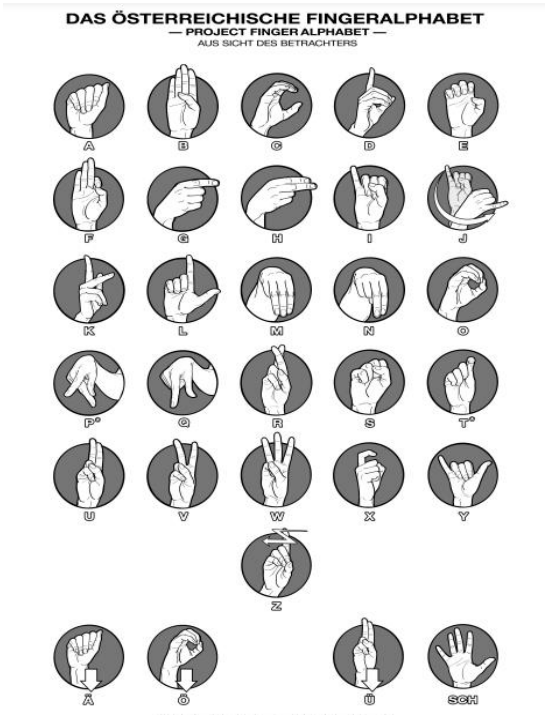
Similar to spoken languages, sign languages show regional variants and dialects. This is also the case for ÖGS. ÖGS has various dialects or variants across the country of Austria, like a variant in Styria, Vorarlberg, Salzburg or Carinthia. These dialects can be further differentiated between regional variants that are predominately used in a specific area like in Villach or Wolfsburg (cities in Carinthia).

However, in most instances, these variants display a substantial degree of overlap, enabling signers from all parts of Austria to communicate and understand each other easily (Skant et al., 2002). The dialectal distinctions are most noticeable in the lexicon and manual alphabet (Schalber, 2006).

2.2.4 *Structure and Characteristics*

In ÖGS the international manual alphabet is predominantly used for spelling (Schalber, 2006). This alphabet is used to name handshapes, so the handshape used to depict the letter A is called A-handshape, the handshape to depict letter B is called B-handshape and so on. An illustration of this alphabet including the German Umlauts (ö, ä, and ü) can be found in Figure 1 below.

Figure 1 | *Finger Alphabet of ÖGS including Handshapes for the German Umlauts*



Note. Source: https://fingeralphabet.org/

ÖGS, like most other natural sign languages, consists of manual signs as well as non-manual markings. The before-mentioned minimal features or phonemes of a sign (handshape, location, orientation and movement) are limited by the ÖGS morphology and phonology to only a specific set of

handshape configurations, hand orientations, movements and places of articulation in ÖGS (Schalber, 2006). Table 1 gives an overview over the manual and non-manual parameters used in ÖGS.[2]

Table 1 | *Overview of Manual and Non-Manual Parameters in ÖGS*

Handshape	The most important handshapes are the A-handshape, A-handshape with spread thumb, B-handshape, B-handshape with spread thumb, B-handshape with thumb placed in the palm, C-handshape, F-handshape, G-handshape, H-handshape, L-handshape, O-handshape, S-handshape, V-handshape, V-handshape with bent fingers, X-handshape, Y-handshape, 5-handshape (all fingers spread), 5-handshape with bent fingers, 5-handshape with middle finger stretched forwards (Skant et al., 2002, p. 241-243). For an illustration of these handshapes see Skant et al. (2002)
Location	back and top of head, forehead, ear, nose, cheek, mouth/lips, chin, neck, shoulder, chest, armpit, upper arm, forearm, wrist, abdomen, and thigh (Skant et al., 2002, p.27)
Movement	Straight arcuate, circular, spiral, zigzag, serpentine, single joint movement, finger play, local movement, complex iconic movement (Skant et al., 2002, p.28-32)
Non-Manual Markers	facial expression, mouth gestures, mouthings as well as body posture/movement and line of sight (Skant et al., 2002, p.32)

Possible mouth gestures in ÖGS include puffed out or tucked cheeks, blowing, kissing lips, or opened mouth. Mouth gestures in ÖGS can be interpreted as adjectival modification (Skant et al., 2002).

Mouthings in ÖGS can help to distinguish between minimal pairs such as METALL (metal) and SILBER (silver)[3], which show identical manual components and can only be differentiated by means of

[2] Note here that the goal of this master's thesis is not to describe the grammar of ÖGS in detail but to give a rough overview. Therefore, the structure of ÖGS will only be shortly outlined. For an overview over the grammar of ÖGS see Skant et al. (2002).

[3] The videos for these ÖGS signs can be found in the LedaSila database with the IDs #35309 and #29220.

mouthing. The mouthing can also further specify the referent. For instance, the sign for BUCH (book) may be accompanied by the mouthing of the word *[bibel]*(bible) to show that the book is a bible (Skant et al., 2002). However, not all signs are combined with mouthings, especially if the meaning is too complex to express it in one mouthing as in the case of classifier constructions [4] (Skant et al., 2002).

Lackner (2017) described several head and body movements and identified their functions (for a detailed description see Lackner (2017)). For instance, headshaking can be interpreted as negation or raising one's shoulder can be understood as lack of knowledge (Lackner, 2017).

Even though the use of non-manual markings is evident in ÖGS, only few is known about the function of these signals (Schalber, 2006). However, in general, non-manual markings can have various functions and affect all organizational principles of language. They can be crucial for the phonology of lexical signs, they can mark aspect on the level of morphology or sentence type on the level of syntax, they can be used as discourse marker or they can provide prosodic cues (Krebs et al., 2018).

Now that the reader has an overview of the main characteristics of sign languages in general and ÖGS in particular, the next chapter focuses on iconicity, attempting to provide a working definition.

3 What is Iconicity?

At the outset of this chapter, it is crucial to emphasize that there is no single, universally accepted definition of the term *iconicity* (Ortega; 2017). Consequently, this section introduces multiple definitions of iconicity with the intention of identifying shared characteristics that are commonly agreed upon by most definitions. Note here that this master's thesis only focuses on linguistic iconicity.

The term iconicity is often defined as "form-meaning-resemblance" or as linguistic signs that "look like what they mean" (Taub, 2001; Taub, 2012). The Cambridge Dictionary describes iconicity as "the relationship between the form of a sign, such as a word or symbol, and its meaning" ("Iconicity", n.d.). Dingemanse et al. (2015) proposes the definition as "the resemblance-based mapping between aspects of form and meaning" (Dingemanse et al., 2015, p. 604). Thompson (2011) and Perniss et al.

[4] Classifiers are specific handshape configurations that are used to express a certain class of elements like animate entities, things, vehicles etc. It is also possible to express the size and shape or other abstract characteristics of the referent with classifiers (Skant et al., 2002). Therefore, within the articulation of one classifier construction various information is encoded that cannot be expressed in one word or mouthing.

(2010) use a slightly different definition and describe iconicity as "non-arbitrary form-meaning mappings". Novogrodsky and Meir (2020) define iconicity as "relationship of similarity between the two aspects of a word or a sign: its form and its meaning" (Novogrodsky & Meir, 2020, p. 820). Emmorey (2014) defines iconicity as "the perceived (or potentially perceived) resemblance between a linguistic symbol (a sign or a word) and its referent" (Emmorey, 2014, p.1) or as "mapping between meaning and a visual or auditory linguistic form" (Emmorey, 2014, p.1).

The common thread among these definitions is their focus on iconicity as a relationship between the form of the linguistic signal and its corresponding meaning and that this relationship is based on similarity or resemblance with form and meaning showing some sort of connection. Hence, iconicity stands in contrast to arbitrariness which shows no link between form and meaning (Dingemanse et al., 2015).

In some cases, iconicity, described as the relationship between form and meaning, is equated with terms such as guessabilty or transparency (Taub, 2001; Taub, 2012). However, these terms need to be distinguished because transparency and guessability describe the ability to correctly guess the meaning of linguistic signs solely based on the form (Sehyr & Emmorey, 2019). It has been shown multiple times (for instance by Klima & Bellugi, 1980) that non-signers hardly ever guess the meaning of signs correctly even if signs are iconic. Therefore, it seems obvious that non-signers do not simply infer the meaning based on its form. Rather, people set up correspondences and see connections between form and meaning, if meaning is already known (Taub, 2012).

Coming back to the definition of iconicity, all the definitions mentioned above agree on the fact that iconicity refers to the relationship between the form and the meaning. Iconicity describes inasmuch a linguistic form represents or reflects the perceptual or sensorimotor characteristics of the referent (Ortega, 2017). However, Taub (2012) warns that a definition that solely considers form and meaning is too shortsighted as it omits the cultural background of people. Pizzuto and Volterra (2000) found that the meaning of some signs from Italian Sign Language was guessed more easily by European native signers with no proficiency in Italian Sign Language compared to European hearing speakers (both, Italian speakers and speakers of other languages), and some were more transparent for Italian speakers compared to non-Italian speakers or deaf native signers of other sign languages. However, the hearing non-Italian speakers scored lower than Italian speakers. Therefore, it is argued that some transparency might be universal whereas some aspects of the meaning are related to the experience

and cultural background of the non-signers (Pizzuto & Volterra, 2000). In line with this assumption are the findings of Occhino et al. (2017). In their experiment, the authors showed that two different groups of native signers (DGS signers and ASL signers) rated the iconicity in signs of their native language significantly higher than in signs from foreign languages which is taken as evidence that the perception of iconicity is influenced by the signer's language experience. Taub (2012), hence, does not understand iconicity as a connection between form and referent alone but rather proposes a definition of iconicity that takes into account conceptualization as well as culture. This means that people's assessment of iconicity is shaped partially through shared human experience and experience unique to specific culture and societies. Hence, iconicity is not objective; rather it is highly subjective and refers to the relationship between mental models of image and referent (Taub, 2001; Taub, 2012).

What is more, iconicity shows two characteristics: Firstly, iconicity is limited by language-specific rules. For sign languages, this means that not all possible hand configurations can be used to represent meaning. Therefore, it is possible that different sign languages use similar strategies or try to depict meaning similarly (in that the same aspects about a referent are highlighted). However, the articulation of meaning may differ as linguistic conventions of each language limit the ways in which meaning can be expressed. Additionally, it is to note that iconicity is not categorial but continuous. Therefore, the meaning of some signs might be easier to understand for people, whereas other form-meaning mappings are hard to access (Ortega, 2017).

Regarding the question, how iconicity is accessed, Emmorey (2014) proposes the structure-mapping theory and describes iconicity as analogical relation between the sign's form (phonological representation) and its mental image of the referent's concept (semantic representation). These two representations are structurally aligned if a one-to-one correspondence between the sign's form and the referent's representation (or vice versa) can be set up. This means one aspect (and only one) of the sign's form may map to one aspect of the referent's representation. Consequently, it is not possible for one aspect to map on more aspects at the same time (Emmorey, 2014). According to this theory, different signs show a different degree of overlap between the representation of the sign's phonology and its semantic representation (Ortega, 2017). Signs showing a high degree of overlap are considered as more iconic.

So, to sum up, iconicity should not be understood as a pure resemblance-based relationship between meaning and form because it is shaped through various other factors, such as cultural and

social background or language experience (Ortega, 2017; Taub, 2012). In this master's thesis, iconicity is understood as subjective perception of analogical relations between the mental images of the form and the meaning. In the next chapter, special attention is dedicated to the question which possibilities speakers and signers have to express meaning iconically.

4 Ways to Express Iconicity in Languages

Before delving into specific aspects of each language modality and exploring the strategies that connect form and meaning, this section will briefly illuminate overarching principles of iconicity that apply across languages.

One fundamental principle is known as the *iconicity of sequence*. This principle posits that the order of linguistic forms reflects the chronological order of events (Perniss et al., 2010). So, the sentence "Sue went to school and ate lunch" is likely to be interpreted as two actions that happen sequentially with the action mentioned at the beginning of the sentence being conducted before the second one. So, Sue went to school first and subsequently ate lunch.

Another key principle is the so-called *principle of proximity* (Klann, 2014), sometimes referred to as the *iconicity of contiguity*. This principle describes a tendency to position semantically related forms closer to each other than semantically unrelated forms. Note here, that this principle was foremost investigated in speech, however, it is assumed that comparable patterns exist in sign languages (Perniss et al., 2010).

A third principle, the *principle of quantity*, involves a relationship between length or complexity of form and the depth of meaning. In short, a more complex form encodes more information and conveys a more complex meaning. For instance, some languages express plurality through reduplication of the singular. In Bahasa (an Austronesian language) orang means human and orang orang means humans. Other languages, like German and English, express plurality through adding certain suffixes like in Katze (cat), Katz*en* (cats). In each case the plural form is structurally more complex than the singular (Klann, 2014).

These language-general principles provide a broad framework for understanding how both spoken and signed languages establish connections between linguistic form and meaning. However, as they are general principles applicable to all languages, the subsequent discussion will briefly examine

modality -specific strategies to link form and meaning. Therefore, a short look will be taken at how acoustic languages utilize form to convey meaning before delving into a more detailed exploration of strategies of iconicity specific to sign languages.

4.1 Iconicity in Spoken Languages

Spoken languages are expressed through the aural modality which is why content can only be conveyed acoustically and sequentially. Hence, spoken languages are limited concerning their ways to iconically express meaning to strategies mimicking sounds or acoustic aspects of the referent and the linear ordering of events. Therefore, abstract nouns or shapes and sizes of three-dimensional objects are very hard if not impossible to acoustically describe in the spoken language signal (Klann, 2014).

In spoken languages, one also finds the expression *sound symbolism* to refer to iconic relations between form and meaning. The most obvious examples for highly iconic words that were used to argue against the idea of arbitrary links between linguistic forms and meaning are *onomatopoeia*. These are expressions that usually mimic the sound of animals (*meow*) or the typical sound of objects in motion (*bang*) (Perniss et al., 2010). This phenomenon is generally considered to be rare, as it is argued that referents associated with certain sounds do not occur very often in languages (Klann, 2014). Another type of iconicity mapping that is related to onomatopoeia is *phonaesthesia*. In such words, one usually finds consonant clusters at the beginning or end of the word that are correlated with similar meanings, e.g., words starting with gl- (e.g., glow, glitter) are associated with low intensity light, whereas words ending with -ack (e.g., crack, whack) are connected with energetic actions and words beginning with -wr are associated with twisting. So, in these cases, the acoustics of those sounds resemble the sound of the meaning (Perniss et al., 2010).

Iconic mapping in every language is, to some degree, conventionalized. Nonetheless, it seems to be the case that there exist some universal principles for the occurring iconicity mappings. Back vowels (e.g., a, u) and voiced consonants are more likely to be associated with big, round and heavy things, whereas voiceless consonants and high vowels (e.g., i) evoke smaller or jagged objects (Perniss et al., 2010). Maurer et al. (2006) demonstrated that adults as well as 2,5-year-olds are more likely to match nonwords containing round vowels (like bouba or goga) with round shapes, and nonwords with unrounded vowels (like kiki and titej) with jagged or angular shapes, which is also known as the Bouba-Kiki-effect. This universal tendency might be explained by the fact that the shape of the mouth while producing a sound resembles the (shape of the) referent. This tendency is also found in the animal

kingdom: A larger vocal tract is more likely to produce back vowels (lower resonances) which indicates that it is a large animal, whereas front vowels (high resonances) of a short vocal tract point to a smaller animal. This provides evidence that these universal tendencies for sound-symbolism are rooted in our genes (Perniss et al., 2010).

4.2 Iconicity in Sign Languages

Since sign languages use the visual-spatial channel, iconicity can also be expressed by highlighting perceptual similarities between sign and meaning in the visual domain. In most cases, at least one of the manual components is used to represent aspects of the meaning, and hence to create a from-meaning-correspondence (Novogrodsky & Meir, 2020). In what follows, different types and strategies of iconicity in sign languages will be introduced.

There are two primary methods for categorizing iconic signs. One approach is to classify signs based on their *degree of* iconicity, while the other is to categorize them by the *type* or *strategy of iconicity* they employ. In the upcoming sections, both approaches will be introduced.

As was already mentioned, iconicity is subjective and hence there are different degrees and types. A rough differentiation can be made between *absolute* and *relative* iconicity (Dingemanse et al., 2015). Absolute iconicity describes a one-to-one mapping between the linguistic form and meaning (as in onomatopoeia), whereas the second term refers to mappings between form and meaning that are based on analogical relations (which is often the case for signs in sign languages as will be outlined later in this chapter) (Dingemanse et al., 2015).

Furthermore, Klima and Bellugi (1980) proposed to differentiate the signs according to the degree to which they are understood by non-signers and define four different stages of sign iconicity. *Transparent* signs build the first stage and are easily connected with their referent (e.g., the sign for TO-DRINK directly imitates the act of drinking). The meaning of *translucent* signs, at the second stage, is not as obvious as the one of transparent signs, however, it is still possible to grasp some aspects of the meaning (for instance, in the ÖGS sign for KÖNIG (king) or PRINZ (prince), the crown is depicted[5]). On the third stage can be found *obscure* signs. These signs show a link to their referent, nonetheless, it can be the case that one needs to know the meaning at first to observe the connection (e.g., the ASL sign for

[5] The videos for these ÖGS signs can be found in the LedaSila database with the IDs #20210 and #31015.

HOLLAND represents the traditional Dutch bonnet). At the fourth stage are so-called *opaque* signs that, as the name indicates, show no relation to their referent (Ortega, 2017).

The approaches just mentioned try to create a broad distinction depending on how iconic the forms are. However, forms can also be distinguished according to how exactly form-meaning-mappings are set up. Taub (2012) differentiated between two different forms of iconicity use: *purely iconic* forms and *iconic and metaphorical* forms. A form is considered purely iconic if aspects of the referent's perceptual image are directly reflected in the form of the linguistic item, such as shape, sound or movement (Taub, 2001). This would be the case for the ÖGS sign TRINKEN (to drink) where the sign looks like as if the person would drink or take a sip from the glass. Consequently, purely iconic linguistic items can only refer to a concrete referent that is perceivable with our sensory system (Taub, 2001). However, if abstract meanings want to be expressed, conceptual metaphors can be combined with iconicity. For instance, the abstract meaning TO-THINK in ASL can be expressed by using a concrete gesture resembling an object piercing through the skull. This image is used to establish the link to the effortful action that finally is successful (thinking about something that then comes to one's mind). Therefore, this is an example of iconic as well as metaphorical usages of signs (Taub, 2012).

A further common differentiation between types of iconicity is between signs representing actions and signs representing perceptual aspects of the referent. For instance, Sehyr and Emmorey (2019) used the differentiation between handling (or hand-as-hand iconicity) and instrument signs (hand-as-entity iconicity) in their analyses of ASL. The initial category encompasses signs where the manual movement mirrors the motion the hand would undergo if the action were physically performed (Sehyr & Emmorey, 2019). Taub (2012) refers to this as full-size mapping, where the signer's hand replicates the real-life hand movement. In contrast, hand-as-entity signs, as described by Sehyr and Emmorey (2019), feature the hand representing an object, potentially also indicating the typical movements associated with that object. Taub (2012) labels these signs as hand-size mappings. Ortega et al. (2014) on the other hand differentiated between action-based and perceptual-based signs. Here, comparable to Sehyr and Emmorey (2019), action-based signs include the representation of the action that is associated with the referent, whereas the perceptual-based signs try to represent the shape or physical appearance of the referent (Ortega et al., 2014).

4.2.1 Taub's (2001) Classification

An even more fine-grained distinction between types of iconicity can be found in Taub (2001). According to Taub (2001), there are different ways to iconically map form onto meaning. For instance, the shape of the articulators, arms, fingers, and hands, can refer or represent locations, shapes or movements. It is also possible to trace the path or outline of referents or to depict the temporal aspect of actions. In what follows, each of those strategies will be briefly described.

4.2.1.1 Entities Represent Themselves

One possibility is that physical entities (e.g., people, animals or objects) represent themselves in the discourse. Although this is practically possible for any form of communication (signed or spoken - you could always refer to a person next to you by pointing to them), the signs of sign languages take a special status in this regard, as this pointing is part of the grammar and lexicon. Thus, sign languages take advantage of the all-time presence of the signer's body. For instance, some body parts are expressed by pointing to the respective body part (e.g., NOSE). This is also the case in ÖGS. In Figure 2, the ÖGS sign for NASE (nose) is illustrated. Here, the signer points to the nose to refer to the referent "nose".

Figure 2 | *Illustration of the ÖGS sign NASE (nose)*

Note. Source: LedaSila, ID: #4726

4.2.1.2 Shape-for-Shape-Iconicity

A second option is the shape-for-shape iconicity. This type of iconicity does not establish the link between form and meaning through a pointing gesture but rather through an attempt to create a mental image of the referent. One possibility to do this is by using the shape of the articulators to imitate the shape of the referent. Intuitively, signers know which parts of the body are relevant for the

encoding of the meaning, or which parts are irrelevant and are not part of the iconic mapping. An example is the sign for TREE in ASL. In this case, the non-dominant hand represents the ground whereas the upright dominant arm builds the trunk of the tree, with the spread hand as leaves and branches or treetop. The rest of the body is not part of the sign and hence the iconic mapping (Taub, 2001). Figure 3 below depicts the ÖGS sign for BAUM (tree) which is very similar to the ASL sign and also uses the upright arm to represent the trunk and the hand as representative of the treetop.

Figure 3 | *Illustration of the ÖGS sign BAUM (tree)*

Note. Source: LedaSila, ID: #33681

4.2.1.3 Movement-for-Movement-Iconicity or Path-for-Path Iconicity

The path-for-path-iconicity is also sometimes referred to as movement-for-movement-iconicity (Klann, 2014). This type of iconicity frequently coincides with the aforementioned shape-for-shape iconicity. In case the shape of the articulators already resembles the shape of the referent, it is possible to adjust the articulator's movement in a manner that replicates the movement of the actual referent.

4.2.1.4 Path-for-Shape-Iconicity

The path-for-shape-iconicity represents another strategy of iconicity. Contrary to the shape-for-shape-iconicity, in the path-for-shape-iconicity the signer's hand configuration itself does not resemble the shape of the referent. Instead, the articulators "draw" a shape or trace a path in space which mirrors the shape of the referent. For instance, when signing the ÖGS sign HAUS (house) or the ASL sign HOUSE, both flat hands are used to trace the outline of a house, starting at the pointed rooftop and moving the hands down the two vertical walls. In Figure 4, the ÖGS sign for HAUS (house) is depicted. The arrows indicate the direction of movement.

Figure 4| *Illustration of the ÖGS sign HAUS (house)*

Note. Source: Own Figure. The video of the sign can be found in the LedaSila database, ID: #3605

With this strategy, it is impossible to also express how the referent moves through space, like it is possible in the movement-to-movement-iconicity. The path-for-shape-iconicity, hence, can only indicate the static form in space. Moreover, like for the shape-for-shape-iconicity, only certain parts of the articulators are interpreted as being relevant for the mapping, and only parts of the movement are part of the iconic mapping. This strategy is commonly employed to describe the shape or form of objects (Taub, 2001).

4.2.1.5 Space-for-Space-Iconicity

Another strategy that co-occurs with other strategies of iconicity is the space-for-space iconicity. In this strategy, the location in the signing space can be understood as representing a location in the mental space. The used signing space can vary from being very limited to involving the whole space around the signer. This type of iconicity is closely connected with the shape-for-shape and path-for-shape iconicity. In these cases, one typically finds a mapping between the signing space and mental space that preserves the relative distance between the locations. The iconic mapping is limited to the signing space of the sign itself. As an example, one can use the ASL sign TREE or the ÖGS sign BAUM again. Here, the spread dominant hand is located above the forearm representing the mental image people usually have about trees as having branches and leaves or the treetop above the trunk (Taub, 2001).

4.2.1.6 Size-for-Size-Iconicity

The size-for-size-iconicity can easily be combined with the shape-for-shape- and the path-for-shape iconicity as well allowing for the representation of the referent's relative size of its constituent parts or its absolute size. Usually, the size of the respective parts of the shape traced by the path-for-shape-iconicity corresponds to their relative sizes. For the shape-for-shape-iconicity, this is not

necessarily the case because the created shapes are more limited to the possible shapes of the articulators and, hence, are more to be understood as schematic. Nonetheless, in the ASL example TREE (or the ÖGS sign BAUM) the sizes of the respective parts (trunk and treetop) closely reflect the relative sizes of the actual parts of a tree. Moreover, signers can also convey information about the absolute size of referents. For instance, signers may use their body to refer to the size of body parts or objects that are worn on the body like bracelets. Signers can also provide information about the absolute size of objects by depicting the dimension of the referents explicitly (Taub, 2001).

4.2.1.7 Number-for-Number-Iconicity

The number-for-number-iconicity is a special case of iconicity in that the number of referents can be expressed through the number of articulators involved in the signing event. A simple example can be observed in the ASL (Taub, 2001) and ÖGS signs for numbers from ONE to FIVE, where the number of extended fingers directly represents the actual number.

4.2.2 *Müller's (2014) Classification*

Another approach to differentiate between techniques to represent meaning was brought forward by Müller (2014) and initially aimed to describe gestures. She proposes the following four modes that will be introduced shortly: *acting, representing, drawing* and *molding*. This first three strategies will be of particular interest in this master's thesis.

4.2.2.1 Acting

In this mode, the motion of the signer's hands tries to depict the actual manual movement, like in grasping or holding an object. So, the production of the sign should look like the movement performed by the action that the gesture describes (Müller, 2014). This means, the body of the signer represents itself and the hands are interpreted as real hands showing how objects are manipulated (e.g., smoking) or how intransitive actions are carried out (e.g., running) (Ortega & Özyürek, 2020). Figure 5 illustrates the ÖGS sign RAUCHEN (to smoke). Here, the signer imitates the act of smoking.

Figure 5| *Illustration of the ÖGS sign RAUCHEN (to smoke)*

Note. Source: Own Figure. The video of the sign can be found in the LedaSila database, ID: #28269

4.2.2.2 Representing

In the representing mode, the hands act as representative of the referent and try to imitate the shape or action of the referent (Müller, 2014). Note here, that the biggest difference to the previously mentioned acting strategy lies in the fact that in the representing strategy, the signer's hands are interpreted as the referent and not as hands itself. For instance, Figure 6 shows an illustration of the ÖGS sign SCHREIBEN (to write). Here, the flat hand can be interpreted as paper or surface to write on, and the right hand mimics the act of writing something down.

Figure 6 | *Illustration of the ÖGS sign SCHREIBEN (to write)*

Note. Source: LedaSila, ID: 28793

4.2.2.3 Drawing

In this mode, the hands try to "draw" or trace the contour or outline of the referent's shape (for instance the sign for HOUSE) or the movement in space (Müller, 2014). This strategy is similar to the path-for-shape iconicity described in Taub (2001). This strategy is best described by the example for the ÖGS sign for HAUS (house) (see Figure 4 in section 4.2.1.4).

4.2.2.4 Molding

In this strategy, the form of the handshape configuration tries to resemble the shape of the referent, like forming a bowl with both hands (Müller, 2014). Figure 7 depicts the ÖGS sign for TOPF (pot) and shows that the hands are formed like a vessel or pot.

Figure 7 | *Illustration of the ÖGS sign TOPF (pot)*

Note. Source: LedaSila, ID: 30646

Hwang et al. (2017) use a modified classification and differentiate between three major iconic strategies: Manipulation, object and *personification* strategy from which the latter will be of greatest interest for this master's thesis. The manipulation strategy can be further divided into the handling and the instrument strategy. In the handling strategy, similarly to the acting strategy, the signer's arms represent the real arm of a person, whereas in the instrument strategy the arm of the signer also depicts the shape of the referent tool as well. These two strategies are summarized as manipulation strategy due to their close relatedness that the signer's body is representative for the human actor itself and its motions using the referent object. The object strategy depicts the referent object itself, for instance by trying to show the shape or the contour of the object. The *personification* strategy uses the signer's arms and body to represent the body or body parts of the referent (Hwang et al., 2017). For instance, animals are depicted by trying to represent the most typical features, like rabbit ears or the snapping mouth of a crocodile. Figure 8 shows the ÖGS sign for HASE (rabbit), wherein the hands highlight the rabbit ears to refer to the animal rabbit.

Figure 8| *Illustration of the ÖGS sign HASE (rabbit)*

Note. Source: LedaSila, ID: 13375

In summary, regardless of the level of detail in their distinctions, it appears that all approaches aim to at least distinguish signs that convey meaning by depicting the associated action or movement from signs that convey meaning by representing the form, shape, or other attributes of the referent. The study of this master's thesis will particularly focus on the strategies *acting, drawing, representing*, and *personification*. However, before delving into a more detailed explanation of the study, the following chapter explores the potential role that iconicity might play in language acquisition.

5 The Role of Iconicity in Language Acquisition

This chapter will review research investigating the impact of iconicity on language acquisition. It has been assumed for a long time that iconicity plays no role in language processing (Perniss et al., 2010). However, recent research in spoken languages unanimously comes to the conclusion that iconicity influences language processing (Perniss & Vigliocco, 2014). It is argued for iconicity to have an impact on language acquisition and learning as iconic forms are thought to facilitate solving the problem of referentiality. By means of perceptual features conveyed through the language signal, it should be easier to detect the referent and to match form and meaning (Ortega, 2017; Perniss et al., 2018). This assumption is supported by evidence demonstrating that infants acquire iconic forms first (Thompson et al., 2012; Caselli & Pyres, 2017; Dingemanse & Nielsen, 2020) and that the early vocabulary inventory of infants includes a lot of iconic forms (Novogrodsky & Meir, 2020). Moreover, numerous studies have presented abundant evidence that iconicity facilitates word learning (e.g., Imai et al., 2008). Additionally, as mentioned in chapter 4.1, infants are sensitive to the roundedness of vowels and associate round vowels with round objects and unrounded vowels with jagged objects, which demonstrates as well that spoken language includes iconic forms and that iconicity influences language acquisition (Maurer et al., 2006; Novogrodsky & Meir, 2020).

Concerning sign languages, the picture looks different. Early work on the impact of iconicity on sign language learning or acquisition came to contradictory conclusions. The finding of Klima and Bellugi (1980) is often taken as example to neglect the facilitation effect or influence of iconicity on sign acquisition. Klima and Bellugi (1980) found that adult hearing non-signers only correctly guessed the meaning of 10 % of transparent signs which they took as indication that people might not rely on iconic form-meaning mappings. However, as already mentioned in chapter 3, transparent signs should not be equated with iconic signs since transparency describes the ability to infer the meaning solely based on the sign's form whereas iconicity describes the ability to recognize similarities between the form and the *already known* meaning (Taub, 2012). Additionally, Orlansky and Bonvillian (1984) argued that children acquiring a sign language do not depend on sign iconicity as their world knowledge to make form-referent associations still needs to be developed and they are cognitively not mature enough to grasp the concept of iconicity. Orlansky and Bonvillian (1984) demonstrated in their longitudinal study that the majority of young infants' vocabulary was not iconic and that only a third of the learned signs were iconic which is why other features such as frequency of the language signal are suggested to influence sign learning. According to Newport and Meier (1985) infants acquiring sign language from birth are still too young to understand the relationship between form and meaning. For instance, the ASL sign MILK represents the process of milking a cow which might be evident to adults but not necessarily to young infants who lack this specific knowledge (Ortega, 2017). In line with these results is the work by Tolar et al. (2008) which suggests that the capability to infer the meaning of iconic signs by its form develops gradually during the preschool years, becoming most apparent around the age of 2.5 to 3 years. Tolar et al. (2008) state that it is unlikely that signers acquire words by means of iconicity, rather it seems to be the case that only by the age of 3 years, children understand the iconic component of the signs which enhances language development. Since by the age of three years children already access a large vocabulary, it is argued that iconicity does not help sign acquisition from early on as it is not accessible by children (Ortega, 2017).

Another argument against the role of iconicity as key factor in language acquisition is based on findings from Anderson and Reilly (2002), Woolfe et al. (2010) or Rinaldi et al. (2014). These authors demonstrated that sign languages are acquired along the same timeline as spoken languages with receptive skills preceding productive skills. Rinaldi et al. (2014) additionally showed that deaf children use the same signs from Italian Sign Language corresponding to spoken Italian words that the age-matched control group of hearing Italian speaking children uses. This means both groups of children

acquire the same lexical items first because they live in similar environments and are confronted with the more or less same objects and actions. As a result, it is proposed that the key to language acquisition is not iconicity, but rather the frequent presence of these lexical items in the children's linguistic input (Ortega, 2017). However, these results need to be treated with caution as factors such as degree of iconicity or the caregiver's input were not considered (Ortega, 2017). Perniss et al. (2018) found that deaf native signing parents tend to modify iconic signs more often than arbitrary signs from BSL when communicating with infants. This modification could be realized through simple repetition of the sign, lengthening the production or enlarging the sign by increasing movement excursion. Through this modification it is possible to highlight iconic features about the signal and thus to support to find the link between form and meaning (Perniss et al., 2018).

Recent research, however, provided evidence against the view that iconicity does not facilitate language acquisition. Thompson et al. (2012) for instance showed that deaf children indeed acquired iconic signs from BSL right from the beginning. The authors argue that iconicity helps to tighten the connection between linguistic form and its meaning and demonstrated that iconicity plays a role in facilitating the sign learning from the beginning. What is more, Thompson et al. (2012) showed that, irrespective of phonological complexity, iconicity is an indicator that predicts sign comprehension as well as production from early on. It was also found that the older the child gets, the greater the advantage of iconicity. Thus, Thompson et al. (2012) infer that the function of iconicity is to link linguistic structures with human experience which facilitates language acquisition. More recently, Caselli and Pyres (2017) replicate the finding of Thompson et al. (2012) for ASL and demonstrated as well that iconicity predicts sign acquisition, however, they also state that other statistical properties of the language signal such as frequency and the sign's neighborhood density facilitate sign acquisition. Moreover, Ortega et al. (2014) argued that the type of iconicity matters since action-based signs (signs depicting how the referent is manipulated) are predominantly used by and in communication with deaf native signing infants and favored over perceptual-based signs (signs depicting perceptual aspects of the referent like form or shape) in Turkish Sign Language. This might be due to the fact that action-based signs are more easily linked to the motor schemas (Ortega et al., 2014). Caselli and Pyres (2020), however, argue that in fact it is the degree of iconicity that facilitates sign learning. The degree of iconicity is highly correlated with the type of iconicity, with signs depicting actions being more iconic than perceptual signs on average, which is why it seems that infants produce more action signs,

however, in fact they prefer highly iconic forms which is why not type but degree of iconicity is crucial for predicting sign acquisition (Caselli & Pyres, 2020).

Additional supporting evidence for the facilitation effect of iconicity comes from the field of second language learning. Several studies with hearing non-signers could demonstrate that iconic signs are more easily recalled correctly than arbitrary signs (see for instance Lieberth & Gamble, 1991). Interestingly, Ortega and Morgan (2015) found that iconicity negatively affects the accuracy of sign production in hearing non-signers. In their experiment, hearing non- signers were taught BSL signs and after the training phase, it was tested how accurate the signs were remembered and produced. They found differences in the production of the phonemes, with correct handshapes being the most difficult to reproduce, but more importantly in this regard, they found that non-signers produced iconic signs less accurately than arbitrary signs. This might be due to the fact that iconicity facilitates access of meaning for non-signers which could be the reason that the phonological structure (the correct handshape, location, movement and orientation of hands) is neglected. Consequently, non-signers pay more attention to preserve the signs' iconic features at the expense of correct phonological composition. So, the findings from second language learning suggest that iconicity facilitates the acquisition of meaning but hinders the acquisition of formal aspects of the language signal (Ortega, 2017).

In summary, despite early research refuting the impact of iconicity on early language acquisition, the aforementioned findings collectively suggest otherwise in that they demonstrate that iconicity plays a significant role in language acquisition, regardless of the language modality. Presently, the perspective that iconicity is a fundamental feature in both signed and spoken languages, operating at both the lexical and structural levels, is widely accepted (Perniss et al., 2010). Nevertheless, the precise interplay between iconicity and other factors, such as frequency, word category, or strategies of iconicity, as well as the mechanisms underlying these facilitation effects, remains largely unclear (Caselli & Pyres, 2020), therefore, the following chapter summarizes what is so far known about possible aspects influencing the degree of iconicity.

6 Iconicity and its Influences

Research investigating the degree of iconicity in sign languages and aspects that influence the degree of iconicity is very limited to this date. The first insights into iconicity stem from crosslinguistic research investigating the use of iconic strategies in native signers and hearing non-signers. Padden et

al. (2013) examined how hearing non-signers and native signers of ASL, New Zealand Sign Language (NZSL), and Al-Sayyid Bedouin Sign Language (ABSL) use iconic strategies to describe hand-held tools (such as a mop or comb) and found that non-signers show a strong preference to use the handling strategy to depict hand-held-tools, whereas signers across all three languages exhibited a more pronounced preference for the instrument approach over the handling approach. Additionally, it was noteworthy that signers from different languages demonstrated varying inclinations, with ASL and ABSL signers displaying a stronger affinity for the instrument approach compared to NZSL signers. In a second experiment, Padden et al. (2015) examined the use of the two strategies of iconicity, *handling* and *instrument strategy,* in signers of ASL and hearing non-signers in response to pictures and videos depicting hand-held tools. For hearing non-signers, a preference for handling forms was observed in the video condition, while instrument forms were preferred in the picture condition. ASL signers, on the other hand, did not exhibit an overall preference for handling forms. In the picture condition, they favored instrument forms when identifying or naming tools using nouns. In the video condition, ASL signers used instrument forms for nouns referring to tools, while verbs exhibited a preference for handling forms. The study revealed that ASL signers employ different iconic strategies based on the grammatical category of lexical signs, with handling forms more commonly used with verbs, and instrument forms more frequently used with nouns. This aligns with ASL's grammatical means of distinguishing between nouns and verbs, illustrating the influence of language (experience, modality) on iconic strategy preferences in signers. Hwang et al. (2017) investigated eight sign languages[6] and the gestures of hearing American non-signers to find out how concepts such as tools, animals, and fruits and vegetables are expressed. They showed that certain semantic classes reveal preferences for specific forms of depiction, in both gestures and signs. Tools, for instance, were mainly produced with manipulating representations (the head and upper body of the signer correspond to the actual body parts of humans), animals reveal a tendency to be depicted through the personification strategy (the signer's body correspond to (parts) of a non-human body), and fruits and vegetables are often identified with the object strategy (the signer's hands try to depict the shape or physical form of the referent). These results show that independent of language modality and language experience, a tendency how to depict meaning visually by means of the body is present in humans.

[6] American, Japanese, German, Israeli, and Kenyan Sign Languages, Ha Noi Sign Language of Vietnam, Central Taurus Sign Language of Turkey, and Al-Sayyid Bedouin Sign Language of Israel

Perlman et al (2018) extended the knowledge about iconicity in a different direction and examined how iconicity in BSL, ASL, spoken English and Spanish is influenced by semantic variables (e.g., concreteness), lexical class and semantic category. The results revealed several important findings. Iconicity is present in both signed and spoken languages, with positive correlations observed between iconicity ratings across all four languages, indicating that iconicity is not limited to a specific modality. However, iconicity varies significantly based on the semantic properties and categories of words or signs. Regarding semantic properties, concreteness and haptic strength are positively correlated with iconicity in sign languages whereas auditory strength was only positively correlated with iconicity in spoken languages. The influence of other semantic properties varied between languages. Regarding lexical class, verbs tend to be highly iconic in both signed and spoken languages, while adjectives are more iconic in spoken languages. Moreover, iconicity varies across specific semantic categories, with manual actions, body parts, and clothes being highly iconic in signed languages, whereas in spoken languages, nouns related to vehicles and adjectives representing properties tend to be more iconic. This study highlights universal principles in iconicity across different languages and modalities. Simultaneously, it points to major differences in iconicity ratings depending on semantic or lexical properties of the linguistic signal.

Additional insights into influencing aspects of the degree of iconicity were provided by Sehyr and Emmorey (2019). They analyzed the ASL-LEX database and investigated differences in the degree of iconicity depending on language experience (signers vs. non-signers), word category (nouns vs. verbs), strategy of iconicity (handling signs vs. representative signs) and handedness (one-handed vs. two-handed signs). They found that the iconicity ratings of ASL signs differs between signers and non-signers, with non-signers showing significantly higher iconicity ratings than signers suggesting that linguistic knowledge and experience affect iconicity perceptions differently. Additionally, in line with the findings of Perlman et al. (2018), verbs were rated higher for iconicity than nouns. Regarding strategy, handling signs (highlighting how the referent is manipulated) were more iconic than entity signs (that represent perceptual features of the referent) in the ASL sample. Concerning handedness, non-signers rated one-handed and two-handed signs similarly, while signers rated two-handed signs as more iconic. These findings provide evidence that in ASL iconicity is influenced by lexical category, iconic mapping strategy, and sign handedness, with differences between signers and non-signers in their perceptions.

Another important insight is provided by Ortega and Özyürek (2020). While they did not examine sign languages directly, they investigated the production and perception of silent gestures in non-signers (gestures produced by non-signers to depict a certain meaning). In particular, they focused on the interplay between degree of iconicity, strategy of iconicity and semantic categories[7]. They found systematic patterns in the use of strategies of iconicity, with specific strategies favored for different semantic categories. When non-signers had to produce silent gestures, they predominately generated acting signs. The other three strategies were used comparatively more infrequent. The acting strategy was used mostly for actions (with and without object) and for manipulable objects whereas unmanipulable objects were also depicted through drawing and representing signs. To depict animate entities, participants favored the personification strategy. Regarding the perception of silent gestures, non-signers rated actions with objects highest for iconicity, followed by actions without objects, manipulable objects, animate entities and unmanipulable objects. Iconicity ratings varied across semantic categories and depending on the strategy, with actions having the highest ratings, particularly when depicted through the acting strategy. This study revealed that, regardless of the strategy of iconicity, actions were generally considered more iconic than objects, and animate entities fell in between. Thus, this shows that certain (combinations between) strategies of iconicity and semantic categories are more iconic than others**.** These results are the first to demonstrate an interaction between degree of iconicity and semantic category as well as strategy of iconicity, which is why these categories and strategies are used in this master's thesis as well to investigate these two aspects influence the degree of iconicity in ÖGS signs.

To sum up, this theoretical framework should have highlighted the importance of investigating iconicity in sign language in much more detail in order to gain a more nuanced understanding of not only how iconicity affects language acquisition or language processing in general but also how different aspects such as lexical class, semantic category, or strategy of iconicity affect the degree of iconicity. Consequently, the current master's thesis aims to contribute to this ongoing research by gathering iconicity ratings for ÖGS and simultaneously investigating the relationship between the degree of iconicity and lexical class, semantic category, as well as strategy of iconicity.

[7] Ortega and Özyürek (2020) used the strategies acting, representing, drawing and personification and the semantic categories action with object, action without object, manipulable object, unmanipulable object and animate entity.

PART TWO: Empirical Design

7 Experiment

The following chapter will delve into the specifics of the experiment's methodology by outlining the motivation to investigate iconicity. The second part of this chapter will present the hypotheses and will describe how they were assessed. Therefore, the whole process from stimuli selection to conducting the survey as well as the subsequent data analysis will be explained.

7.1 Motivation

Lexical databases are a crucial instrument in research to improve our understanding of acquiring, learning and processing languages. For spoken languages, there are many databases with detailed information about properties of spoken and written words such as frequency, neighborhood density, length etc. (such as the English Lexicon Project by Balota et al., 2007). Repeatedly it has been demonstrated how important these aspects of spoken and written words are for processes related to language underscoring the fundamental role such databases play in controlling for these aspects in psycholinguistic experiments (Caselli et al., 2017).

However, when we look at sign languages and the availability of databases, the situation appears less promising. Sign languages are notable for containing numerous signs that are inherently motivated by iconicity, offering a unique opportunity to explore the impact of iconicity on language processing or acquisition. To explore this inquiry, it is essential to gather ratings that evaluate the degree of iconicity inherent in signs. The first iconicity rating for a sign language was conducted by Vinson et al. (2008) for BSL. An additional milestone achievement in this domain was the creation of the first large-scale database for ASL by Caselli et al. (2017). This database is called ASL-LEX and encompasses critical information about frequency, iconicity, and various lexical properties (such as initialization, lexical class, compounding, fingerspelling), as well as sign length. However, these iconicity ratings for ASL and BSL together with an iconicity rating for DGS (conducted by Trettenbrein et al., 2021) represent some of the very few examples of publicly available iconicity ratings. To my knowledge, there has not been collected any iconicity rating for ÖGS yet, which is why the aim of this master's thesis is to provide the first iconicity rating for 328 ÖGS signs to enable future research to deepen our understanding about sign language-specific and language-general processing or acquisition. Moreover, the second aim of this master's thesis is to investigate how the degree of iconicity is influenced by aspects such as lexical

class, semantic category, and strategy of iconicity. In the following section, the hypotheses of this master's thesis are introduced.

7.2 Hypotheses

Sehyr and Emmorey (2019) found that in the ASL dataset, verbs were rated significantly higher for iconicity than nouns. The same pattern was found in a crosslinguistic comparison of iconicity ratings by Perlman et al. (2018), where verbs were rated significantly higher for iconicity than nouns in the BSL and ASL (and English) dataset. Therefore, the following hypothesis is proposed:

H1: *ÖGS verbs will be rated significantly higher for iconicity than ÖGS nouns.*

Concerning the relationship between semantic class and iconicity, Perlman et al. (2018) additionally found that in the two sign languages BSL and ASL, nouns belonging to the semantic category body parts and clothes (e.g., skirt, mouth) or small artifacts (e.g., knife or book) as well as verbs representing manual actions (e.g., draw, throw) were rated highest for iconicity. Partly in line with these results is the finding of Ortega and Özyürek (2020), indicating that silent gestures for actions with and without objects are rated as more iconic than gestures for objects and animate entities. Unmanipulable objects are reported to be rated as least iconic (Ortega & Özyürek, 2020). Furthermore, Ortega et al. (2019) showed in one of their experiments that when non-signers had to guess the meaning of signs from NGT, actions were guessed correctly more frequently compared to signs for objects because non-signers tended to assume that signs for objects (e.g., SPOON) refer to the action that is associated with the object, in this case eating. Based on these findings, the following two subhypotheses were set up:

H1a: The highest iconicity rating is expected for actions with objects.

H1b: The lowest iconicity rating is expected for unmanipulable objects.

Regarding strategy of iconicity, Sehyr and Emmorey (2019) showed that acting signs (signs representing the action that is associated with the referent) are more iconic than signs using strategies to represent the shape or contour of referents. In line with this finding, is the work of Caselli and Pyres (2019) demonstrating that handling signs show a higher degree of iconicity than entity signs (that highlight perceptual characteristics of the referent). Additionally, Ortega and Özyürek (2020) found that non-signers foremost use the acting strategy to depict the meaning in silent gestures and that

actions and manipulable object were rated highest for iconicity if they exploit the acting strategy. Therefore, it is expected to find similar patterns in ÖGS, which is why the second hypothesis and its subhypotheses look as follows:

H2: It is expected to find the highest iconicity rating for signs with the acting strategy.

H2a: It is expected to find the highest iconicity rating for nouns with the acting strategy.

H2b: It is expected to find the highest iconicity rating for verbs with the acting strategy.

In what follows, it will be described how these hypotheses were tested.

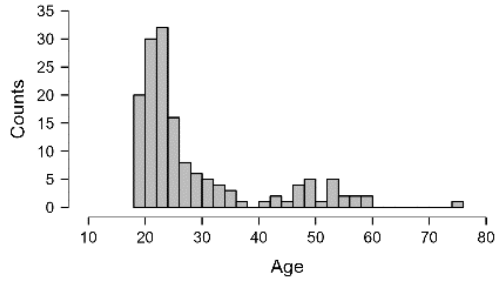
7.3 Experimental Design

The master's thesis includes an online survey asking hearing non-signers to rate the degree of iconicity of ÖGS signs on a scale from 1-7. The survey was conducted with hearing non-signers to ensure that their ratings primarily capture the visual resemblance between form and meaning, without being influenced by prior language experiences or knowledge regarding the origin of specific signs (Caselli et al., 2017). The survey was created in SoSciSurvey. All instructions are given in written German and are adapted and extended from previous studies examining iconicity ratings (Vinson et al., 2008; Caselli et al., 2017; Trettenbrein et al., 2021) that all use a very similar description of the task. The instructions can be found in Appendix B.

7.4 Participants

In total, 151 (104 females, 45 males, 2 divers) participants took part in the study. The mean age is 29,033 years (*SD* = 11.504, range = 18-76 years). Figure 9 below illustrates the distribution of participants' age. Concerning their education, most participants either went to university (n = 60) or hold a high school diploma (n = 73). The other 18 participants completed compulsory education (n = 2), apprenticeship (n = 10) and vocational middle school without matura (n = 6). All participants acquired German as their first language, live longer than 2 years in Austria and report no experience with ÖGS or any other sign language.

Figure 9 | *Age Distribution of Participants*



Note. The x-axis indicates the age in years, y-axis indicates the number of participants belonging to a specific age range.

7.5 Stimuli

The list of tested items was drawn from various sources. The majority of ÖGS signs was chosen based on the stimuli of previous studies from ASL (Caselli et al., 2017), DGS (Trettenbrein et al., 2021) and BSL (Vinson et al., 2008). ÖGS signs were preferably chosen if signs with equivalent or similar meaning were already used in the other three studies. Additionally, some stimuli were taken from the list "Franz's 100 häufigste Gebärden"[8], found on the platform MACH'S-AUF! (a website for ÖGS signs[9]). Moreover, a list of atelic and telic verbs was included as well as some of the most frequent words in written German. Additionally, there is a set of 23 homonyms included. These are signs which can be translated either as noun or as verb (Organisation (organization)-organisieren (to organize)). In this case, this video is included twice in the stimuli set, one time with the translation as noun and one time translated as verb. These stimuli are evenly distributed across the four questionnaires, with only one translation per sign is included. Participants are either provided with the translation as verb *or* as noun to see whether one translation (hence one lexical class) is rated as more iconic than the other. Table 2 in Appendix A shows which homonyms are used. In alignment with Caselli et al. (2017), Trettenbrein et al. (2021) and Vinson et al. (2008), all signs included are lexical signs. The dataset does not consist of compound signs, classifier constructions or fingerspelled signs. All stimuli are recordings of

[8] This list can be found under the following link: https://suche.machs-auf.at/search?q=%23liste%3A%22Franz%27s+100+h%C3%A4ufigste+Geb%C3%A4rden+%28%C3%96GS%29%22

[9] This platform can be found under the following link: https://machs-auf.at

ÖGS signs from LedaSila (a lexicon database for ÖGS[10],), except for one (the video for E-MAIL) which is taken from the GESTU-platform of the Technical University of Vienna[11]. In Appendix C, for each sign it is indicated which video was shown in the questionnaire by indicating the ID from the LedaSila database (and in the case of E-MAIL, the link is given). The videos are about 2 seconds long and participants can watch the video as often as they want.

As control conditions, some signs are presented with an incorrect translation (incorrect stimuli). Since ÖGS signs are often accompanied with a mouthing that mimics the spoken word form, it was important to combine an iconic sign with a translation that is similar to the mouthing of the sign. For instance, the video for the sign REISEN (to travel) was combined with the translation "reiten" (ride), since the spoken word form is similar. The list with all incorrect stimuli can be found in Table 2 in Appendix A. Additionally, there is a condition where the participants are asked to choose value 5 independent of degree of iconicity (the value-5-condition). This procedure was adapted from Caselli et al. (2017).

In total, 328 ÖGS signs will be tested (145 verbs, 146 nouns and 23 adjectives, 8 adverbs and 6 common conversational elements). Beforehand, all verbs and nouns are assigned to the corresponding strategy of iconicity (if possible) and semantic category. The procedure for making these assignments will be detailed in section 7.6. A list of all tested signs with the strategy of iconicity and semantic category they were assigned to can be found in Appendix C.

7.6 Assignment of the Signs to the Semantic Categories and Strategies of Iconicity

In the following section, the approach by which the ÖGS verbs and nouns were assigned to the semantic categories and strategies of iconicity will be illuminated. Regarding the assignment of the ÖGS verbs and nouns to the strategy of iconicity that best describes how meaning is encoded, it has to be noted at first that there is no uniform or right assignment to each strategy. This decision is partly subjective; however, the goal was to carefully assign each sign to the best appealing strategy. Nonetheless, it is important to emphasize at this point that the categorization of signs is subject to individual interpretation, and varying perspectives can lead to different assignments within the chosen strategies

[10] This database can be found under the following link: https://ledasila.aau.at/General/Default.aspx

[11] This platform can be found under the following link: https://fachgebaerden.tsc.tuwien.ac.at/httpsfachgebaerdentsctuwienacatgebaerdenactionlist/

of iconicity. The same is true for the assignment to the semantic categories. Here, it may be the case as well that different individuals place signs in different semantic categories based on reasonable results.

7.6.1 Assignment of the Signs to Semantic Category

The semantic categories that are investigated in this master's thesis are the same as in Ortega and Özyürek (2020) and encompass: action with object, action without object, manipulable object, unmanipulable object and animate entities. Additionally, the two semantic categories psychological signs and body parts will be investigated. Table 2 provides an overview over the semantic categories and some examples.

Table 2 | *Overview over the Semantic Categories used in this Master's Thesis*

Semantic category	**Examples**
Action with object	NÄHEN (to sew), KOCHEN (to cook), ZERBRECHEN (to break)
Action without object	LAUFEN (to run), SCHWIMMEN (to swim), KLETTEREN (to climb)
Manipulable object	ZAHNBÜRSTE (toothbrush), FAHRRAD (bicycle), BUCH (book)
Unmanipulable object	REGEN (rain), SCHNEE (snow), MUSIK (music)
Animate entity	HASE (rabbit), KATZE (cat), HEXE (witch)
Psychological sign	DENKEN (to think), TRAUM (dream), WISSEN (to know)
Body parts	HAND (hand), KÖRPER (body), KOPF (head)

For the assignment of the semantic categories, the following criteria were used: Verbs could either be assigned to actions with or without object. This means for every verb it was considered if the action it describes requires an object or if the signer itself could do the action without anything else. Easy to assign were intransitive actions such as running, walking, dancing, staying or crying. Here, the action does not need any object to be conducted, hence, these verbs were assigned to the category action without object. Actions with objects are verbs that describe actions requiring an object such as driving a car (car), catching or throwing (an object such as a ball), sewing (a needle and a thread), drinking (a drink). Trickier were actions that could be done with an object and without an object such as *kill*. Here, the video of the ÖGS sign was analysed and as the sign looks like stabbing someone, it was

decided to assign it to the group of actions with objects, since stabbing requires a sharp object such as a knife.

Nouns could be assigned to the group of animate entities, manipulable or unmanipulable objects. Animate entities were the easiest to assign because this group consists of all signs referring to animals (bird, rabbit, pig, dog etc.) and humans (woman, priest, uncle, child etc.). The semantic category manipulable object is used for objects that are usually relatively small and can be used or touched with the hands. In the set of ÖGS signs, this was the case for food such as potatoes, or cherries, clothes such as a belt, pants, an umbrella or other small objects such as letter or a laptop. On the other side, unmanipulable objects were classified as those that are relatively big (such as a house, hotel, or moon) or carry a more abstract meaning (like decision, month, organization, etc.) and are usually not manipulated with hands. Moreover, it is to note that this set of ÖGS signs consists of some signs that could not be assigned to one of the above-mentioned semantic categories. This was, on the one side, the case for a set of nouns and verbs referring to psychological or cognitive processes (e.g., WISSEN (to know), TRAUM (dream) DENKEN (to think)) which are produced around the head of the signer. Therefore, it was decided that both. Nouns and verbs, describing psychological or cognitive processes are assigned to the category *psychological signs.* This is by the way the only semantic category that includes nouns and verbs. On the other hand, the ÖGS sample includes three signs referring to the human body or parts of it (the ÖGS signs KÖRPER (body), HAND (hand) and KOPF (head)). These signs all describe the human body or parts of it which is why they are categorized into the semantic category *body parts.*

7.6.2 Assignment of the Signs to Strategy of Iconicity

The strategies of iconicity that were used in this master's thesis are taken over form Ortega and Özyürek (2020) and include *acting, representing, drawing* and *personification*. Additionally, two more strategies (*metaphorical* and *direct referencing*) are used in this master's thesis that describe how the two additional semantic categories body parts and psychological signs link form and meaning. Table 3 gives an overview with a short description of each strategy and a few examples.

Table 3 | *Overview over the Strategies used in this Master's Thesis*

Strategy	Description	Examples
Acting	Signers use their hands to mimic real actions, making signs look like the actual movements they represent or that are associated with the object (Müller, 2014; Ortega & Özyürek, 2020).	LAUFEN (to run), BABY (baby), SCHWIMMEN (to swim)
Representing	The hands symbolically stand in for referents by modulating the handshape configuration so that it looks similar to (parts of) the referent (Ortega & Özyürek, 2020).	AUFSTEHEN (stand up), SCHREIBEN (write)
Drawing	The hands try to "draw" or trace the outline of the referent's shape or the movement in space (Ortega & Özyürek, 2020).	HAUS (house), BRIEF (letter)
Personification	The signer's arms and body are used to embody the (non-human) referent's body or specific characteristics, such as portraying animals by highlighting distinctive features like rabbit ears or a crocodile's snapping mouth (Hwang et al., 2017; Ortega & Özyürek,	HASE (rabbit), VOGEL (bird), HEXE (witch)
Metaphorical	Abstract meanings can be depicted through conceptual metaphor, in which a concrete movement is understood as a substitute or metaphorical representation for the actual intended meaning (Taub. 2012).	DENKEN (to think), TRÄUMEN (to dream), WISSEN (to know)
Direct referencing	The referent is present and directly used in communication to refer to it (Taub, 2001)	KÖRPER (body), HAND (hand), KOPF (head)

In what follows, the procedure or criteria that were used to assign the ÖGS verbs and nouns to the strategies are described and illustrated with examples. Appendix C provides a description of each sign to support the rationale behind its strategy assignment.

As *acting* signs were counted those signs that use a movement that is clearly connected to the referent. This means the movement of the signer's hands should look like some form of hand movement resembling an action. In acting signs, the movement of hands corresponds directly to the movement that is described by the sign or that is associated with the referent. One example is the ÖGS sign RASIEREN (to shave) (see Figure 10), here the hand slides along the cheek up and down and mimics the actual action of shaving one's beard. Another typical example for the acting strategy is the ÖGS sign BABY (baby) in Figure 11. Here the signer's hands are formed as if the person would hold a baby, and the action of rocking a baby to sleep is carried out. The ÖGS sign for ESSEN (to eat) in Figure 12 is another

example for acting signs in that here the signer brings the hand to the mouth as if she would be eating something.

Figure 10 | *Illustration of the ÖGS sign RASIEREN (to shave)*

Note. Source: Own Figure. The video of the sign can be found in the LedaSila database, ID: #26388

Figure 11 | *Illustration of the ÖGS sign BABY (baby)*

Note. Source: LedaSila, ID: # 13279

Figure 12 | *Illustration of the ÖGS sign ESSEN (to eat)*

Note. Source: LedaSila, ID: #12931

As *representing* signs were counted those signs that create a form-meaning link through a handshape configuration that resembles the referent. This implies that, unlike the acting strategy, the movement involved in representing signs does not mimic the actual action it describes or that is associated with the meaning. Instead, the sign is better understood as a representative of the referent. So, the signer's hand is not to be interpreted as hands themselves but as referent or object that is closely connected to the referent. One example is the ÖGS sign HUBSCHRAUBER (helicopter) in Figure 13. Here, the upper hand shakes and represents the rotor blades or wings of a helicopter. Another example is the homonym sign KÜSSEN (to kiss) or KUSS (kiss) in Figure 14. Here, the thumbs press against the rest of the finger and both hands move towards each other and after touching each other, they move away from each other. This movement is repeated, and the signer's hands can be understood as representative of the lips of the persons kissing each other. One further example is the ÖGS sign STEHEN (to stand) in Figure 15 where the inverted V-shaped fingers represent the two feet that move down and touch the flat hand which is to be understood as floor or ground.

Figure 13 | *Illustration of the ÖGS sign HUBSCHRAUBER (helicopter)*

Note. Source: LedaSila, ID: #34537

Figure 14 | *Illustration of the ÖGS sign KÜSSEN/KUSS (to kiss/kiss)*

Note. Source: Own Figure. The video of the sign can be found in the LedaSila database, ID: #23074

Figure 15 | *Illustration of the ÖGS sign STEHEN (to stand)*

Note. Source: Own Figure. The video of the sign can be found in the LedaSila database, ID: #37492

As *personification* signs were counted those signs that refer to non-human referents by depicting the most typical features. In chapter 4, the example for the ÖGS sign HASE (rabbit) has already been introduced. Additional examples for this strategy are the ÖGS sign HEXE (witch) in Figure 16 where the long crinkly nose that is often a typical characteristic of witches in fairytales is used to refer to the meaning "witch", and the ÖGS sign for KATZE (cat) in Figure 17 where the whiskers of cats are depicted to refer to the concept of cats.

Figure 16 | *Illustration of the ÖGS sign HEXE (witch)*

Note. Source: LedaSila, ID: #43985

Figure 17 | *Illustration of the ÖGS sign KATZE (cat)*

Note. Source: Own Figure. The video of the sign can be found in the LedaSila database, ID: #3922

As *drawing* signs were counted those signs that refer to the referent by depicting its outline. A typical example for this strategy is the ÖGS sign HAUS (house) were the signer's hands pace the contour of a stereotypical house and was already described in section 4.2.2.3. Further examples for this strategy are the ÖGS sign SCHOKOLADE (chocolate) in Figure 18 and BRIEF (letter) in Figure 19, both depict the rectangular form of a chocolate bar and a letter or envelope.

Figure 18 | *Illustration of the ÖGS sign SCHOKOLADE (chocolate)*

Note. Source: own figure. The video of the sign can be found in the LedaSila database, ID: #46140

Figure 19 | *Illustration of the ÖGS sign BRIEF (letter)*

Note. Source: own figure. The video of the sign can be found in the LedaSila database, ID: #10352

As already mentioned in the previous section, some signs that could not be assigned to one of the semantic categories could not be assigned to one of these strategies as well. This was the case for the semantic group of psychological signs. Therefore, in this master's thesis, signs describing psychological or cognitive processes are classified as *metaphorical* as proposed by Taub (2001) (see section 4.2). Metaphorical signs are signs with an abstract meaning (e.g., DENKEN (to think)) that are expressed by means of a metaphor. In the case of TO-THINK in ASL this is realized through a hand movement that refers to an object piercing through the skull which equals the action of effortful thinking (Taub, 2012). This pattern can also be observed for the ÖGS signs assigned to the group of psychological signs. The place of articulation of all these signs is located around the head of the signer and because the meaning of those signs is more or less abstract, it was decided to assign these signs to their own strategy. This group classified as the *metaphorical* strategy includes 16 signs in total. One prime example of this is found in ÖGS signs, such as IDEE (idea) in Figure 20. In this sign, the index finger moves away from the temple, symbolizing the release of an idea from one's mind. This sign is considered

iconic, as it aligns with the shared understanding that ideas originate in the brain and when a person has an idea, it figuratively emerges from their thoughts. Another instance is the ÖGS sign ÜBERLEGEN (to ponder/carefully think) in Figure 21. In this sign, the fingers appear to dig into the temple, visually representing the arduous act of deep thinking and delving into one's own thoughts. The act of "drill-ing" into the head metaphorically signifies the process of searching or excavating through one's thoughts in pursuit of answers or the desired insight.

Figure 20 | *Illustration of the ÖGS sign IDEE (idea)*

Note. Source: Own Figure. The video of the sign can be found in the LedaSila database, ID: #27257

Figure 21 | *Illustration of the ÖGS sign ÜBERLEGEN (to carefully think)*

Note. Source: LedaSila, Id; #17899

As *direct referencing* signs are classified the three signs describing body parts. In alignment to Taub (2001), all those signs share the characteristics that the referent is present, and meaning is expressed by directly referring to it. Taub (2001) states that this is often done through pointing to the object (see section 4.2.1.1), however, for the three signs in this ÖGS set, this is not the case. In these ÖGS signs, meaning is not expressed by a pointing sign or a classical deictic sign with the index finger, nonetheless, this set of stimuli is special in that these are the only signs in the rated ÖGS sample that incorporate the referent directly into the sign. One example is the ÖGS sign HAND (hand) (see Figure 22). Here, the signer refers to the human hand by directly showing the referent – a human hand.

Figure 22 | *Illustration of the ÖGS sign HAND (hand)*

Note. Source: LedaSila. ID: #23632

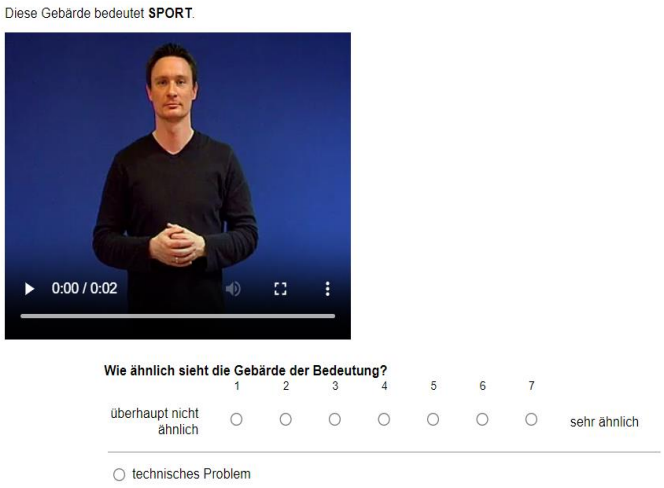
If none of the strategies seems to describe the sign or no link between form and meaning was evident, then these signs were assigned to the group "no strategy" and excluded from the analysis. An example of this is the ÖGS sign BUB (boy), where the signer tips onto the temple with the extended index and middle finger, showing no apparent connection to the meaning "boy". Similarly, in the ÖGS sign VATER (father), the signer brings the extended index and middle fingers first to the chin and then to the forehead, also displaying no obvious connection to the meaning "father". One exception in this regard was the sign for GOTT (god). Even though this sign showed a relatively high mean iconicity rating, it was excluded from the analyses regarding strategy of iconicity and semantic category because none of the strategies and semantic categories seem to be suitable for the sign.

7.7 Procedure

The stimuli are categorized into four questionnaires: A, B, C, and D. Each questionnaire comprises between 93 and 94 stimuli. These questionnaires are further organized into five sections, with each section containing between 15 and 20 stimuli. In total, questionnaires A and B contain 94 stimuli, while questionnaires C and D consist of 93 stimuli. Between the sections, participants can take a short break. The ordering of the stimuli within each section is randomized. Since participants are randomly assigned to one of the four questionnaires and do not rate all signs, eight signs are included in all questionnaires to test for consistency across groups of participants. Moreover, in each questionnaire control conditions are included. On the one side, there are six stimuli in each questionnaire that are presented with a wrong translation (incorrect stimuli). On the other side, there are two instances per questionnaire, where the participants are asked to choose value 5 independent of degree of iconicity (the value-5-condition). In every trial, participants will be presented with videos displaying ÖGS signs along with their corresponding written German translations above the video. Below each video on the

same page, there is a Likert scale ranging from 1 to 7, where 1 signifies no connection between the form and the meaning, and 7 indicates a high degree of iconicity. Participants are asked to rate how closely the sign visually represents its intended meaning, essentially assessing the sign's iconicity. Furthermore, participants have the option to check a box in case they encounter any technical issues. An example trial from the survey is given in Figure 23.

Figure 23 | *Screenshot of one Exemplar Iconicity Rating*



Before the actual testing starts, participants will be shown a detailed description and instructions of the task. The instruction is adapted from previous questionnaires of Trettenbrein et al. (2021), Caselli et al. (2017) and Vinson et al. (2008). Here, an example for an iconic sign will be presented (the ÖGS sign KROKODIL (crocodile)). Additional examples for a non-iconic sign (the ÖGS sign SCHWESTER (sister)) and a sign that lies between these extremes (the ÖGS sign SCHAF (sheep)) were added. The instructions can be found in Appendix B. After the instructions, participants complete a test trial with the three ÖGS signs KAULQUAPPE (tadpole); HAI (shark) and APFEL (apple) to get familiarized with the question format. The test stimuli were not considered for the final analysis. Thereafter, the actual questionnaire starts. In total, completing the questionnaire should not take more than 20 minutes.

Before the final survey was sent to the participants, a pilot study was conducted in order to make sure that the videos are working and displayed in the way they should and that instructions are clear and easy to understand. The data from the pilot study is not included in the final analysis.

7.8 Analysis Plan

The data is analyzed using the software JASP. Following the data collection phase, a crucial initial step involves data cleaning. Over the span of July 14th to August 18th, 171 questionnaires were recorded. A questionnaire is deemed valid only if a minimum of 3 sections of the iconicity rating is filled out. Consequently, 16 questionnaires are excluded from the subsequent analysis due to the completion of only one or two rating trials. In addition, 4 more questionnaires are excluded for various reasons: one participant did not reside in Austria for more than 2 years, another consistently used the same rating value, one indicated an implausible age, and one was below the age of 18. This leads to a total of 151 questionnaires being retained for further analysis. Within this final dataset, Questionnaire A received 38 ratings, Questionnaire B received 39 ratings, Questionnaire C received 36 ratings, and Questionnaire D received 38 ratings. Worth noting is that, in instances where the test condition (the value-5-condition) is incorrectly filled out, only the section containing the error is excluded from the analysis, while other sections are retained. Such errors may serve as an indicator that participants were not fully attentive, potentially rendering their ratings unreliable.[12].

Prior to the analysis, it is important to assess the validity of participants' ratings, ensuring that they have not resorted to random selection of values or consistently assigned high or low ratings across all signs. Therefore, in alignment with Caselli et al. (2017), each questionnaire contains signs with a wrong translation. The objective is to investigate whether these incorrect stimuli, which inherently lack an iconic form-meaning mapping, receive lower iconicity ratings in comparison to the correct stimuli. To test this, the mean iconicity ratings for the correct and incorrect signs are computed. Subsequently, a Mann-Whitney U test (as a nonparametric alternative to the unpaired t-test) is applied to discern whether a statistically significant difference exists between these two groups of stimuli. This analytical approach is employed to ascertain whether participants' ratings demonstrate a consistent response pattern and discriminate between incorrect and correct stimuli.

Please note that in the subsequent analyses, predominantly nonparametric tests are employed. Prior to conducting each test, a Shapiro-Wilk test is performed to assess the normal distribution of the

[12] For questionnaire A, in total section 3 is excluded 10 times, section 4 is excluded 7 times, and both sections 7 times. For questionnaire B, in total section 3 is excluded 15 times, section 4 is excluded 14 times, and both sections 11 times. For questionnaire C, in total section 3 is excluded 16 times, section 4 is excluded 14 times, and both sections 13 times. For questionnaire D, in total section 3 is excluded 14 times, section 4 is excluded 7 times, and both sections 5 times.

data. In the majority of instances, normal distribution is not observed, leading to the utilization of nonparametric tests. Additionally, the sample sizes for specific groups are often quite small, further justifying the use of nonparametric tests.

After the validity of the rating is tested, the two hypotheses and their subhypotheses of this master's thesis can be assessed. Note here, that for the analysis only verbs and nouns are considered. The hypotheses are again given below.

H1: ÖGS verbs will be rated significantly higher for iconicity than ÖGS nouns.

H1a: The highest iconicity rating is expected for actions with objects.

H1b: The lowest iconicity rating is expected for unmanipulable objects.

H2: It is expected to find the highest iconicity rating for nouns and verbs with the acting strategy.

H2a: It is expected to find the highest iconicity rating for nouns with the acting strategy.

H2b: It is expected to find the highest iconicity rating for verbs with the acting strategy.

Regarding the first hypothesis H1, it is tested whether there is a significant difference in mean iconicity rating between nouns and verbs. Therefore, the mean of the set of verbs and nouns each is calculated and compared by using a Mann-Whitney U test. Subsequently, a small set of homonym signs is analyzed as well to investigate whether in this group, differences can be observed between nouns and verbs regarding mean iconicity rating. Therefore, the mean of homonym nouns and homonym verbs is compared in a Mann-Whitney U test.

In a next step, regarding the two subhypotheses (H1a, H1b), the means for each semantic category are calculated to see which group shows the highest mean descriptively. Additionally, it is tested whether there is a statistical difference in mean iconicity rating depending on the semantic category. To assess this, a Kruskal-Wallis test was used alternatively to a parametric one way ANOVA. If there

was a significant effect, Dunn's Post Hoc Comparisons[13] were conducted to compare the means of each semantic category to find out which semantic categories significantly differ from each other. This analysis was applied to two sets of stimuli: Analysis 1 extended the semantic categories used in Ortega and Özyürek (2020) with the two additional categories psychological signs and body parts. Analysis 2 focused on the semantic categories used by Ortega and Özyürek (2020), excluding psychological signs and body parts.

Regarding the second hypothesis (H2), the primary objective is twofold: Firstly, to identify the strategy of iconicity that participants rated as most iconic, the means for each strategy of iconicity are calculated. Simultaneously, the aim is to investigate whether there exists a significant difference in mean iconicity ratings associated with the different strategies of iconicity. To assess this, a Kruskal-Wallis test is conducted to explore the potential impact of strategy of iconicity. In instances where the Kruskal-Wallis test yields a significant result, Dunn's Post Hoc Comparisons are employed to pinpoint specific strategy differences that are statistically significant. This analysis is applied to three datasets:

(1) A dataset comprising signs with a mean iconicity rating exceeding 4 and categorizable into one of the four strategies proposed by Ortega and Özyürek (2020) (Analysis 3).

(2) A dataset encompassing all signs that could be assigned to one of the strategies, including metaphorical and direct referencing signs (Analysis 4).

(3) A dataset identical to the dataset from Analysis 4 but excluding metaphorical signs and direct referencing signs (Analysis 5).

Considering the two subhypotheses (H2a, H2b), the same methodology is independently applied to the set of nouns and verbs within each of the three datasets, seeking to identify which strategy is rated as the most iconic in each lexical class. As in the initial analysis, to test if there is a significant effect of strategy within the group of nouns or verbs, the Kruskal-Wallis test is used and, if warranted, Dunn's Post Hoc Comparisons. In the case of verbs, in Analysis 3 and 5 only two strategies are found

[13] For the interpretation of the Dunn's Post Hoc Comparison, the *p*-value from the Holm Correction was used. The correction is used to avoid the risk of alpha error cumulation.

which is why the Mann-Whitney U test is used to assess if the differences in mean iconicity rating are statistically significant.

To better understand how the factors semantic category, lexical class and strategy of iconicity interact with each other, an exploratory analysis is included. One aim of this exploratory analysis is to examine whether a distinction in mean iconicity ratings exists depending on the concreteness of the sign's meaning. In pursuit of this investigation, the signs are categorized into two distinct groups: those with concrete meanings and those with abstract meanings. In Appendix C, for each noun and verb, it is indicated whether it is assigned to the group with abstract or concrete meaning. Following this categorization, the mean iconicity ratings s for each of these two groups are calculated and compared in a Mann-Whitney U test to ascertain whether the observed difference in mean iconicity ratings between concrete and abstract meaning carries statistical significance.

In the analyses above, the influence of three distinct factors: lexical class, semantic category, and strategy of iconicity is explored. Each of these factors is investigated individually to understand their unique effects but to delve deeper into the interplay of these three aspects, an additional analysis is conducted to study how these factors interact with one another.

To explore the influence of both strategy of iconicity and lexical class on the degree of iconicity, initially, the distribution of strategies within the group of nouns and verbs is examined. If the degree of iconicity is primarily driven by lexical class (and not solely a consequence of the strategy of iconicity) and verbs inherently possess a higher degree of iconicity than nouns, irrespective of strategy of iconicity, one would expect a higher rating for verbs when exclusively comparing signs belonging to the same strategy. Hence, the two strategies, *acting* and *representing,* which are the only strategies that encompass both nouns and verbs, are analyzed. Within each strategy, the mean iconicity ratings for nouns and verbs are calculated. A Mann-Whitney U test is conducted to determine the statistical significance of the differences between these lexical classes.

To investigate the interaction between semantic category and lexical class, the distribution of the semantic categories in the whole sample and in each lexical class is analyzed. As a second step, Mann-Whitney U tests and Kruskal-Wallis tests are used to investigate whether there are significant differences in mean iconicity rating between the semantic categories within each lexical class.

Regarding the interaction between semantic category and strategy of iconicity, the distribution of strategy across the semantic categories is analyzed to see which are the preferred strategies for each semantic category. Subsequently, to investigate the exclusive impact of semantic category on the degree of iconicity, an analysis is conducted to determine if there is an effect of semantic category within the subset of representing and acting signs. These two strategies are specifically chosen as they encompass both actions and objects. Within each of these strategies, the mean iconicity ratings for each semantic category are calculated. A Kruskal-Wallis test is executed to ascertain if a significant effect of semantic category is observable within the subset of representing or acting signs. In the presence of a significant effect, Dunn's Post Hoc Comparisons is utilized to pinpoint the specific semantic categories exhibiting statistically significant differences.

To test whether the effect of strategy of iconicity is present when accounting for semantic category, the semantic categories animate entity, manipulable object, unmanipulable object, action with object and action without object are analyzed to see if one strategy elicits higher iconicity ratings within one semantic category. Note here that the most prominent strategies are acting and representing. In each semantic category, the mean iconicity ratings in every strategy are calculated and compared in a Kruskal-Wallis test to evaluate whether there is a significant effect of strategy within the set of semantic categories. Notably, in the group of actions, where only the two strategies acting and representing are present, a Mann-Whitney U test is used to determine the statistical significance of the observed differences.

8 Results

The subsequent chapter provides a presentation of the findings derived from these analyses. Starting with the descriptive statistics, the second and major part of this chapter is dedicated to the inferential statistics and the assessment of the hypotheses. At the end of this chapter, the results of the exploratory analysis will be presented.

8.1 Descriptive Statistics

In what follows the results of the descriptive statistics will be presented.

8.1.1 Test Trials

The mean, standard deviation (SD), mode, minimum and maximum for the three stimuli KAULQUAPPE (tadpole), HAI (shark) and APFEL (apple) from the test trial are given in Table 4. The

column "Number of Ratings" shows how many valid ratings were collected and used in the analysis. Note here that these three stimuli were not included in the main analysis.

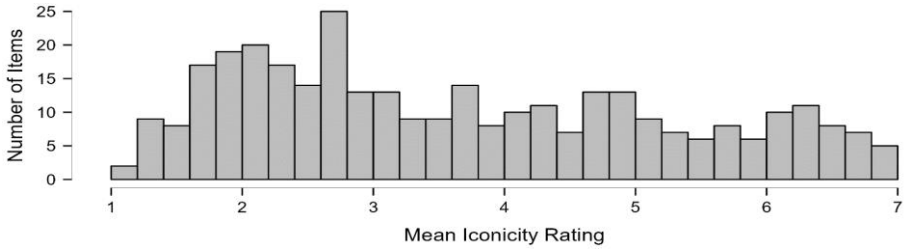
Table 4 | *Descriptive Statistics of the Iconicity Ratings for the Test Stimuli*

	KAULQUAPPE	APFEL	HAI
Number of Ratings	151	151	151
Mode	5.000	2.000	5.000
Mean	4.848	2.536	4.536
Std. Deviation	1.464	1.408	1.540
Minimum	1.000	1.000	1.000
Maximum	7.000	7.000	7.000

8.1.2 Mean Iconicity Rating

The average mean of all ratings was 3.664 (*SD* = 1.608, range = 1.105 – 7.000). Figure 24 below shows the average distribution of the iconicity ratings.

Figure 24 | *Average Iconicity Ratings*



Note. The x-axis illustrates the distribution of mean iconicity rating from 1 to 7, on the y-axis the number of items with the corresponding mean iconicity rating can be seen.

The skewness of the data (0.393) suggests that the data is approximately symmetrical. These results are not in line with the findings that the iconicity ratings from hearing non-signers for ASL (Caselli et al., 2017) and DGS (Trettenbrein et al., 2021) were skewed towards the lower end of the rating scale.

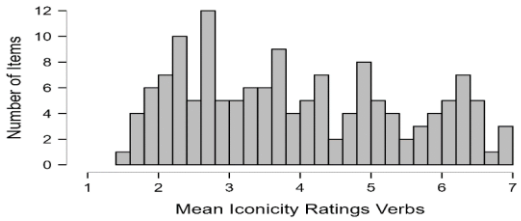
8.1.3 Mean Iconicity Rating per Lexical Class

In what follows, for each lexical class the mean iconicity ratings will be presented.

8.1.3.1 Mean Iconicity Ratings in Verbs

On a 7-point Likert scale, verbs show the second highest mean iconicity rating from all lexical classes (*M* = 3.946, *SD* = 1.516, range = 1.474 – 6.848, n = 145). The distribution of mean iconicity rating in the group of verbs can be seen in Figure 25.

Figure 25 | *Mean Iconicity Ratings in the Lexical Class of Verbs*



Note. The x-axis illustrates the distribution of mean iconicity rating from 1 to 7, on the y-axis the number of items with the corresponding mean iconicity rating can be seen.

The descriptive values for each verb are calculated and given in Table 5 which gives an ordered overview over the 145 ÖGS verbs with the English translation and their mean, SD, mode, minimum, maximum and number of ratings[14]. The column for the mean is color-coded, with greenish fields showing mean iconicity ratings above 4 and reddish fields showing mean iconicity ratings below 3. The verbs are arranged based on their average iconicity rating, beginning with the verbs having the highest mean iconicity rating and concluding with the verb having the lowest mean iconicity rating.

[14] Note that items may vary in their number of ratings for several reasons: some signs, like TRINKEN (to drink), have more ratings as they were included in each of the four questionnaires. Additionally, certain signs may have fewer ratings because they were placed in the third or fourth section of a questionnaire, which was excluded whenever the control condition (value-5 condition) was incorrectly filled out.

Table 5 |*Descriptive Statistics for each ÖGS Verb*

ÖGS Sign	English Translation	Mean	SD	Mode	Minimum	Maximum	Number of Ratings
TRINKEN	drink	6,848	0,619	7	1	7	151
SCHWIMMEN	swim	6,836	0,526	7	3	7	146
SCHLAFEN	sleep	6,801	0,701	7	3	7	146
WEINEN	cry	6,792	0,588	7	5	7	24
ERMAHNEN	exhort	6,541	0,869	7	3	7	37
ZERBRECHEN	break	6,500	1,319	7	2	7	24
GEHEN	walk	6,500	1,007	7	2	7	38
NÄHEN	sew	6,447	0,795	7	4	7	38
NEHMEN	take	6,417	0,841	7	4	7	36
KLETTERN	climb	6,395	0,916	7	2	7	38
ESSEN	eat	6,318	1,110	7	1	7	151
SEHEN	see	6,316	1,165	7	1	7	38
KÜSSEN	kiss	6,308	1,055	7	3	7	39
WERFEN	throw	6,278	0,779	7	5	7	36
BLEIBEN	stay	6,250	0,967	7	3	7	36
KOCHEN	cook	6,211	1,143	7	2	7	38
AUFMACHEN	open	6,194	0,833	7	1	7	31
RADFAHREN	ride a bike	6,128	1,056	7	3	7	39
FANGEN	catch	6,083	1,105	7	3	7	36
DENKEN	think	6,057	1,162	7	2	7	35
LAUFEN	run	6,056	1,351	7	2	7	36
HALTEN	hold	6,000	1,000	6	4	7	35
SCHLEICHEN	sneek	5,946	1,079	6	2	7	37
WARNEN	warn	5,889	1,214	7	2	7	36
ATMEN	breathe	5,816	0,982	6	3	7	38
ÜBERLEGEN	reason	5,774	1,359	7	1	7	31
STEHLEN	steal	5,692	1,592	7	2	7	39
STEHEN	stand	5,658	1,300	7	2	7	38
TÖTEN	kill	5,564	1,410	6	2	7	39
AUSRUTSCHEN	slip	5,484	1,48	7	1	7	31
GEBEN	give	5,395	1,424	6	1	7	38
BESPRECHEN	discuss	5,389	0,934	5	3	7	36
BRINGEN	bring	5,304	1,063	6	3	7	23
RASIEREN	shave	5,222	1,396	6	2	7	36
MERKEN	memorise	5,167	1,579	5	1	7	24
EINSCHLAFEN	fall asleep	5,158	1,305	6	2	7	38
ANKOMMEN	arrive	5,056	1,286	5	1	7	36
ZEIGEN	show	5,048	1,322	5	1	7	21
(ETWAS) WISSEN	know	5,026	1,385	5	2	7	38
VORSTELLEN (IN GEDANKEN)	imagine	5,000	1,542	5	1	7	38
ERINNERN	remember	5,000	1,342	6	1	7	31
LACHEN	laugh	4,974	1,241	5	2	7	38
REITEN	ride a horse	4,972	1,341	5	2	7	36
SPRECHEN	speak	4,957	1,430	5	1	7	23

UMFALLEN	fall over	4,921	1,496	5	2	7	38
TREFFEN	meet	4,875	1,727	5	1	7	24
HINEINGEHEN	enter	4,806	1,167	5	2	7	36
AUFWACHEN	wake up	4,795	1,625	4	1	7	39
FREUEN	be happy	4,727	1,579	4	2	7	22
MIT DEM FLUGZEUG FLIE-GEN	fly by plane	4,718	1,521	5	1	7	39
VERNACHLÄSSIGEN	neglect	4,657	1,748	5	1	7	35
STERBEN	die	4,571	1,399	6	2	6	21
VERHANDELN	negotiate	4,444	1,520	5	1	7	36
VERGESSEN	forget	4,387	1,334	5	2	7	31
PUTZEN	clean	4,333	1,523	5	1	7	24
VERFOLGEN	trace	4,323	1,536	5	1	7	31
TANZEN	dance	4,261	1,544	6	1	6	23
LESEN	read	4,237	1,651	5	1	7	38
SAGEN	say	4,226	1,564	4	1	7	31
SCHREIBEN	write	4,211	1,647	5	1	7	38
ÜBERHOLEN	overtake	4,114	1,967	2	1	7	35
VERBRAUCHEN	consume	4,086	1,597	3	1	7	35
FÖRDERN	fund	4,083	1,442	5	1	6	24
MALEN	paint	4,079	1,549	5	1	7	38
SCHICKEN	send	4,026	1,630	5	1	6	39
VERSCHWINDEN	disappear	4,000	1,319	5	1	6	24
SOLLEN	should	4,000	1,859	2	1	7	23
SEGELN	sail	3,974	1,325	4	1	6	38
ABHOLEN	pick up	3,872	1,472	4	1	7	39
SAMMELN	collect	3,778	1,623	2	1	7	36
BEZAHLEN	pay	3,722	1,523	2	1	7	36
AUSSTEIGEN	get off	3,711	1,271	4	1	6	38
ERFINDEN	invent	3,692	1,794	4	1	7	39
GLAUBEN	believe	3,686	1,451	3	1	7	35
FERNSEHEN	watch TV	3,667	1,414	3	1	6	36
KOMMUNIZIEREN	communicate	3,636	1,560	3	1	6	22
HUSTEN	cough	3,632	1,422	3	1	6	38
FÜHREN	guide	3,609	1,616	3	1	6	23
MÖGEN	like	3,591	1,501	4	1	6	22
AUSWÄHLEN	choose	3,526	1,812	2	1	7	38
TAUCHEN	dive	3,524	1,569	3	1	7	21
TRÄUMEN	dream	3,476	1,632	3	1	7	21
BEKOMMEN	get	3,452	1,823	5	1	7	31
TURNEN	exercise	3,447	1,672	4	1	7	38
AUFBEWAHREN	store	3,306	1,600	3	1	6	36
LERNEN	learn	3,286	1,564	5	1	6	35
FOLGEN	follow	3,273	1,609	5	1	6	22
FINDEN	find	3,250	1,918	1	1	7	36
AUFSTEHEN	get up	3,237	1,497	3	1	6	38
MÜSSEN	must	3,217	1,783	2	1	7	23
AUTOFAHREN	drive a car	3,182	1,878	1	1	6	33

ÜBERSETZEN	translate	3,179	1,722	5	1	6	28
GEBÄRDEN	sign	3,111	1,545	4	1	6	36
VERSTEHEN	understand	3,086	1,245	3	1	6	35
FEIERN	celebrate	3,083	1,501	4	1	6	24
ENTLASSEN	dismiss	3,000	1,604	2	1	6	36
EINSTEIGEN	get on	3,000	1,414	2	1	6	38
WÜNSCHEN	wish	2,921	1,459	3	1	6	38
VERSTECKEN	hide	2,872	1,824	1	1	6	39
UNTERSCHREIBEN	sign	2,839	1,614	1	1	6	31
KOPIEREN	copy	2,795	1,592	1	1	6	39
BESTELLEN	order	2,795	1,436	2	1	6	39
ÜBEN	practice	2,767	1,382	2	1	6	30
SPIELEN	play	2,757	1,606	1	1	6	37
MACHEN	do	2,742	1,460	2	1	6	31
ARBEITEN	work	2,739	1,356	2	1	5	23
LEBEN	live	2,730	1,427	3	1	6	37
SCHAFFEN	accomplish	2,696	1,329	3	1	6	23
PROBIEREN	try	2,696	1,845	2	1	6	23
EMPFEHLEN	recommend	2,692	1,217	2	1	6	39
VERHAFTEN	arrest	2,658	1,475	1	1	5	38
FRAGEN	ask	2,643	1,471	1	1	5	28
IGNORIEREN	ignore	2,526	1,179	2	1	5	38
REPARIEREN	repair	2,526	1,268	2	1	6	38
GRÜSSEN	greet	2,447	1,465	1	1	7	38
KAUFEN	buy	2,421	1,348	1	1	5	38
VERKAUFEN	sell	2,417	1,296	1	1	6	36
BRAUCHEN	need	2,364	1,560	1	1	5	22
SUCHEN	search	2,304	1,363	1	1	6	23
DOLMETSCHEN	interpret	2,286	1,607	1	1	7	28
LIEGEN	lie	2,278	1,466	1	1	6	36
FAHREN	drive	2,270	1,239	1	1	5	37
UNTERSUCHEN	examine	2,258	1,365	1	1	5	31
DÜRFEN	may	2,258	1,125	2	1	5	31
(DIR) ANTWORTEN	answer	2,250	1,189	2	1	5	24
HELFEN	help	2,250	1,228	2	1	6	36
FORSCHEN	research	2,250	1,189	1	1	5	24
ANFANGEN	begin	2,103	1,294	1	1	5	39
ANMELDEN	register	2,083	1,204	1	1	5	36
UNTERRICHTEN	teach	2,083	1,052	1	1	5	36
WARTEN	wait	2,083	1,060	2	1	5	24
KÖNNEN	can	2,077	1,156	1	1	5	39
ENTSCHEIDEN	decide	2,071	1,215	1	1	5	28
REISEN	travel	2,028	1,207	1	1	6	36
TROCKNEN	dry	1,914	1,121	1	1	5	35
KÜNDIGEN	resign	1,903	1,193	1	1	5	31
BELEIDIGEN	insult	1,842	0,945	1	1	5	38
ANZEIGEN	indicate	1,833	1,000	1	1	4	36
ORGANISIEREN	organise	1,833	1,159	1	1	4	36

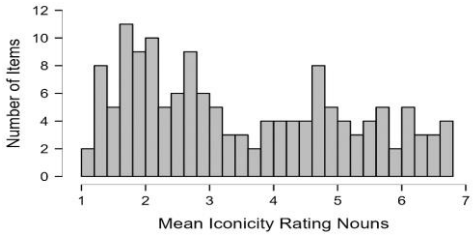
ENTDECKEN	discover	1,806	1,302	1	1	7	31
LÜGEN	lie	1,763	0,998	1	1	5	38
WOLLEN	want	1,645	0,877	1	1	4	31
ABMELDEN	sign off	1,632	0,883	1	1	5	38
PFLEGEN	care	1,605	1,001	1	1	5	38
AUSBORGEN	borrow	1,474	0,830	1	1	4	38

The verbs with the highest mean iconicity rating are TRINKEN (to drink) (*M* = 6.848), SCHWIMMEN (to swim) (*M* = 6.836), SCHLAFEN (to sleep) (*M* = 6.801), WEINEN (to cry) (*M* = 6.792) and ERMAHNEN (to admonish/exhort) (*M* = 6.541). All these verbs show a mean iconicity rating above 6.5.

8.1.3.2 Mean Iconicity Ratings in Nouns

On a 7-point Likert scale, nouns show the third highest mean iconicity rating from all lexical classes (*M* = 3.509, *SD* = 1.650, range = 1.105 – 6.711, n = 146). The distribution of iconicity ratings in the group of nouns is illustrated in Figure 26.

Figure 26 | *Distribution of Mean Iconicity Ratings in the Group of Nouns*



Note. The x-axis illustrates the distribution of mean iconicity rating from 1 to 7, on the y-axis the number of items with the corresponding mean iconicity rating can be seen.

The descriptive values for each noun are given in Table 6. The signs are ordered according to their mean iconicity rating. For each of 146 ÖGS nouns the English translation, mean, SD, mode, minimum, maximum and number of ratings are given.

Table 6 | *Descriptive Statistics for each ÖGS Noun*

ÖGS Sign	English Translation	Mean	SD	Mode	Minimum	Maximum	Number of Ratings
BABY	baby	6,711	0,515	7	5	7	38
IDEE	idea	6,694	0,577	7	5	7	36
GÜRTEL	belt	6,608	0,638	7	4	7	97
AUTO	car	6,603	0,841	7	2	7	151
HANDSCHUH	glove	6,556	0,843	7	3	7	36
BRILLE	glasses	6,447	0,760	7	5	7	38
HÖRGERÄT	hearing device	6,417	0,770	7	4	7	36
EISCREME	ice cream	6,342	1,169	7	1	7	38
HAND	hand	6,324	0,944	7	4	7	37
KAMERA	camera	6,308	1,055	7	2	7	39
BART	beard	6,158	0,855	6	4	7	38
BUCH	book	6,132	1,166	7	3	7	38
FAHRRAD	bike	6,071	0,813	6	5	7	28
KAMM	comb	6,051	1,276	7	1	7	39
HASE	rabbit	6,041	1,198	7	2	7	97
KUSS	kiss	6,000	1,586	7	1	7	36
HAUS	house	5,861	0,899	6	4	7	36
(DAS) WISSEN	knowledge	5,773	0,869	5	4	7	22
KOCH	chef	5,769	1,287	7	3	7	39
MUSIK	music	5,737	1,408	6	1	7	38
HUNGER	hunger	5,727	1,241	6	3	7	22
ZAHNBÜRSTE	tooth brush	5,619	1,024	6	4	7	21
HOSE	pants	5,583	0,996	6	3	7	36
LAPTOP	laptop	5,579	1,200	5	2	7	38
ZIGARRE	cigar	5,579	1,200	5	3	7	38
SCHNEE	snow	5,472	1,253	6	3	7	36
ERINNERUNG	memory	5,273	1,241	5	3	7	22
VERNACHLÄSSIGUNG	neglect	5,270	1,262	6	2	7	37
WOLKE	cloud	5,238	1,480	5	2	7	21
HUBSCHRAUBER	helicopter	5,167	1,424	5	2	7	36
TEIL	part	5,108	1,173	5	3	7	37
KIND	child	5,053	1,739	6	1	7	38
ENTE	duck	5,042	1,367	4	2	7	24
KÖRPER	body	4,955	1,327	6	2	7	22
BRIEF	letter	4,947	1,559	5	1	7	38
ARMBANDUHR	watch	4,868	1,166	5	2	7	38
ENDE	end	4,867	1,196	5	2	6	30
KAULQUAPPE	tadpole	4,848	1,464	5	1	7	151
VORHANG	curtain	4,833	1,404	5	1	7	24
KATZE	cat	4,795	1,321	5	1	7	39
KLEID	dress	4,769	1,347	5	2	7	39
SCHIRM	umbrella	4,750	1,628	5	1	7	36
TÜR	door	4,739	1,214	5	2	7	23
HUND	dog	4,694	1,564	6	2	7	36

JACKE	jacket	4,692	1,301	4	2	7	39
GOTT	god	4,631	1,874	5	1	7	31
FISCH	fish	4,607	1,499	4	1	7	28
HAI	shark	4,536	1,540	5	1	7	151
MOND	moon	4,500	1,466	5	1	7	38
AFFE	monkey	4,444	1,711	5	1	7	151
REGEN	rain	4,417	1,316	4	1	6	24
KOPF	head	4,409	1,469	5	2	7	22
HEXE	witch	4,361	1,477	4	2	7	36
ZENTRUM	center	4,286	1,765	3	1	7	21
GEFÜHL	feeling	4,226	1,499	5	1	7	31
KÖNIG	king	4,205	1,542	3	1	7	39
BAUM	tree	4,184	1,591	5	1	7	38
VOGEL	bird	4,105	1,721	3	1	7	38
KALENDER	calendar	4,051	1,376	5	2	7	39
MAUS	mouse	4,026	1,241	5	1	6	38
HOLZ	wood	4,000	1,656	6	1	6	36
APPLAUS	applause	3,903	1,700	4	1	7	31
KOMMUNIKATION	communication	3,875	1,296	4	2	7	24
TRAUM	dream	3,875	1,424	3	1	6	24
INSEL	island	3,769	1,613	4	1	7	39
VERBRAUCH	usage	3,676	1,454	4	1	7	37
SCHWEIN	pig	3,571	1,502	3	1	7	21
ZUG	train	3,458	1,587	4	1	6	24
BOOT	boat	3,421	1,765	5	1	6	38
FILM	film	3,393	1,343	4	1	6	28
FREUND	friend	3,258	1,653	3	1	7	31
KLEIDUNG	clothes	3,231	1,423	3	1	6	39
FLASCHE	bottle	3,179	1,278	3	1	6	28
DURST	thirst	3,129	1,648	1	1	6	31
PRIESTER	priest	3,125	1,777	1	1	6	24
FLUGZEUG	airplane	3,071	1,720	2	1	7	28
ZAUBER	magic spell	3,048	1,431	3	1	7	21
ARBEIT	work	3,000	1,480	3	1	6	22
ZEIT	time	3,000	1,542	2	1	6	38
KEKS	cookie	2,897	1,619	1	1	7	39
ENTSCHEIDUNG	decision	2,886	1,388	2	1	5	35
UNTERTITEL	subtitle	2,875	1,296	4	1	5	24
LAND	country	2,870	1,325	3	1	6	23
CHEF	boss	2,786	1,548	3	1	6	28
STUNDE	hour	2,783	1,704	1	1	6	23
FEIER	celebration	2,757	1,623	1	1	6	37
KARTOFFEL	potato	2,744	1,618	1	1	6	39
BLUME	flower	2,737	1,309	2	1	5	38
GRAS	grass	2,71	1,532	2	1	7	31
DOLMETSCHER	translator	2,692	1,280	2	1	5	39
FÜHRUNG	guidance	2,629	1,437	2	1	6	35
STADT	city	2,619	1,244	3	1	5	21

SPORT	sports	2,571	1,248	2	1	5	21
APFEL	apple	2,536	1,408	2	1	7	151
GEBÄRDE	sign	2,526	1,538	1	1	6	38
PFEIFE	pipe	2,500	1,794	1	1	7	24
JAHR	year	2,436	1,294	2	1	6	39
SCHULE	school	2,432	1,259	2	1	6	37
TAG	day	2,429	1,720	1	1	6	21
PROBLEM	problem	2,351	1,230	2	1	6	37
PAUSE	break	2,292	1,301	1	1	5	24
BETT	bed	2,211	1,298	2	1	6	38
ENTLASSUNG	dismissal	2,211	1,255	1	1	5	38
SPIEL	game	2,211	1,339	1	1	6	38
NUSS	nut	2,158	1,128	2	1	5	38
ORGANISATION	organisation	2,132	1,298	1	1	6	38
PERSON	person	2,130	1,392	1	1	6	23
E-Mail	E-Mail	2,108	1,125	1	1	5	37
BROT	bread	2,105	1,203	1	1	6	38
ARZT	doctor	2,079	1,100	1	1	5	38
BEISPIEL	example	2,079	1,282	2	1	7	38
SCHOKOLADE	chocolate	2,056	1,286	1	1	5	36
FUNKTION	function	2,045	1,430	1	1	6	22
KIRSCHE	cherry	2,026	1,646	1	1	6	39
JUNGE	boy	2,000	1,257	1	1	5	39
MANN	man	2,000	1,252	1	1	6	38
REISE	journey	2,000	1,063	1	1	4	24
UNTERRICHT	class	2,000	1,142	1	1	4	24
KÄSE	cheese	1,973	1,190	1	1	5	37
HOTEL	hotel	1,889	1,141	1	1	5	36
SOCKEN	socks	1,857	1,153	1	1	5	21
UNTERSUCHUNG	examination	1,816	0,926	1	1	4	38
SCHULD	guilt	1,810	1,327	1	1	6	21
WOCHE	week	1,792	0,932	1	1	4	24
SPASS	fun	1,783	1,278	1	1	6	23
ADRESSE	adress	1,763	0,883	1	1	4	38
GESCHÄFT	shop	1,742	1,154	1	1	5	31
MENSCH	human	1,694	1,142	1	1	6	36
TIER	animal	1,684	1,210	1	1	5	38
EI	egg	1,679	1,124	1	1	5	28
KAFFEE	coffee	1,667	1,325	1	1	6	39
ANFANG	beginning	1,658	1,097	1	1	5	38
MONAT	month	1,652	0,647	2	1	3	23
ELTERN	parents	1,607	1,133	1	1	5	28
SOHN	son	1,571	0,811	1	1	3	21
BRUDER	brother	1,500	1,059	1	1	5	38
OMA	grandmother	1,500	0,688	1	1	3	38
MUTTER	mother	1,474	0,762	1	1	4	38
ABMELDUNG	deregistration	1,452	0,675	1	1	4	31
BANK (GELDINSTITUT)	bank	1,395	0,823	1	1	4	38

PFLEGE	care	1,389	0,599	1	1	3	36
PFERD	horse	1,375	0,647	1	1	3	24
URLAUB	holiday	1,375	1,013	1	1	5	24
VATER	father	1,375	0,711	1	1	4	24
FRAU	woman	1,357	0,678	1	1	3	28
WASSER	water	1,290	0,588	1	1	3	31
OPA	grandfather	1,211	0,474	1	1	3	38
DVD	DVD	1,179	0,476	1	1	3	28
ONKEL	uncle	1,105	0,311	1	1	2	38

The five nouns with the highest mean iconicity rating are BABY (baby) (M = 6.711), IDEE (idea) (M = 6.694), GÜRTEL (belt) (M = 6.608), AUTO (car) (M = 6.603) and HANDSCHUH (glove) (M = 6.556). All these nouns show a mean iconicity rating above 6.5.

8.1.3.3 Mean Iconicity Ratings in Adjectives

On a 7-point Likert scale, adjectives show the fourth highest mean iconicity rating from all lexical classes (M = 3.027, SD = 1.622, range = 1.369 – 6.771, n = 23). Table 7 gives an overview over the descriptive values of each adjective. The adjectives are arranged in descending order of their means, from the highest mean to the lowest mean.

Table 7 | *Descriptive Statistics for each ÖGS Adjective*

ÖGS Sign	English Translation	Mean	SD	Mode	Minimum	Maximum	Number or Ratings
STARK	strong	6,771	0,547	7	5	7	35
LANGSAM	slow	6,636	0,581	7	5	7	22
GUT	good	6,387	0,761	7	1	7	31
GEHÖRLOS	deaf	4,682	1,673	5	2	7	22
SCHNELL	quick	3,652	1,849	4	1	7	23
BÖSE	evil	3,645	1,427	4	1	6	31
LUSTIG	funny	3,182	1,500	3	1	7	22
EINFACH	easy	3,071	1,585	2	1	6	28
SCHRECKLICH	terrible	3,048	1,203	3	1	5	21
ANSTRENGEND	exhausting	2,636	1,177	3	1	5	22
LANGWEILIG	boring	2,605	1,498	2	1	6	38
MÖGLICH	possible	2,429	1,441	1	1	6	35
SCHÖN	beautiful	2,429	1,399	1	1	6	35
ARM SEIN	poor	2,316	1,509	1	1	6	38
GRAUSAM	cruel	2,194	1,167	1	1	5	31
WICHTIG	important	2,167	1,606	1	1	6	24
INTERESSANT	interesting	2,000	1,265	1	1	5	21

SCHLAU	clever	1,889	1,008	1	1	5	36
MÜDE	tired	1,826	1,072	1	1	5	23
GLÜCKLICH	happy	1,742	0,999	1	1	4	31
JUNG	young	1,526	0,797	1	1	4	38
NEU	new	1,421	0,599	1	1	3	38
ALT	old	1,368	0,942	1	1	5	38

The five adjectives with the highest mean iconicity rating are STARK (strong) (*M* = 6.771), LANGSAM (slow) (*M* = 6.636), GUT (good) (*M* = 6.387), GEHÖRLOS (car) (*M* = 4.682) and SCHNELL (fast) (*M* = 3.652). So, three adjectives are rated high for iconicity whereas the majority of adjectives show a rating below 3.

8.1.3.4 Mean Iconicity Ratings in Adverbs

On a 7-point Likert scale, adverbs show the lowest mean iconicity rating from all lexical classes (*M* = 2.837, *SD* = 1.009, range = 1.625 – 4.548, n = 8). Table 8 gives an overview of the descriptive values of adverbs. The adverbs are arranged in descending order of their means, from the highest mean to the lowest mean.

Table 8 | *Descriptive Statistics of the Set of ÖGS Adverbs*

ÖGS Sign	English Translation	Mean	SD	Mode	Minimum	Maximum	Number or Ratings
GESTERN	yesterday	4,548	1,524	6	1	7	31
IMMER	always	4,105	1,607	5	1	7	38
MANCHMAL	sometimes	2,955	1,527	3	1	5	22
HEUTE	today	2,625	1,498	2	1	7	24
MEHR	more	2,526	1,428	1	1	6	38
JETZT	now	2,316	1,093	2	1	5	38
OFT	often	2,000	1,279	1	1	5	23
VIEL	lots	1,625	1056	1	1	5	24

The adverbs with the highest mean iconicity rating are GESTERN (yesterday) (*M* = 4.548), IMMER (always) (*M* = 4.105), and MANCHMAL (sometimes) (*M* = 2.955), which shows already a notably lower mean iconicity rating. The other adverbs all show a rating below 2.7 which shows that form-meaning mappings are not evident in these signs.

8.1.3.5 Mean Iconicity Ratings of Common Conversational Elements

On a 7-point Likert scale, common conversational elements show the highest mean iconicity rating from all lexical classes (*M* = 4.183, *SD* = 2.187, range = 2.097 – 7.00, n = 6). However, this is also the smallest group of lexical items. The descriptive values for the conversational elements are given in Table 9.

Table 9 | *Descriptive Statistics of the Set of Common Conversational Elements in ÖGS*

ÖGS Sign	English Translation	Mean	SD	Mode	Minimum	Maximum	Number of Ratings
HALLO	hello	7,000	0	7	7	7	22
TSCHÜSS (ABSCHIEDSGRUSS)	bye	6,871	0,562	7	4	7	31
DANKE	thank you	3,613	1,783	4	1	7	31
NEIN	no	2,839	1,440	3	1	6	31
ENTSCHUDLIGUNG	sorry	2,679	1,492	1	1	7	28
BITTE	please	2,097	1,076	1	1	5	31

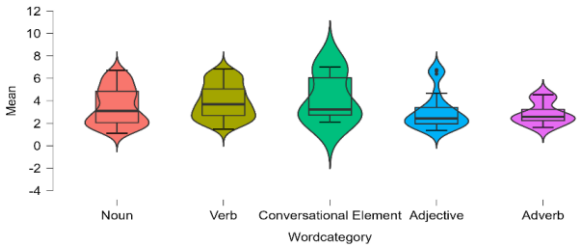
Table 9 shows that the conversational elements with the highest iconicity rating are the signs HALLO (hello) (*M* = 7), this is also the only sign in the sample that received a rating of 7 from all participants, TSCHÜSS (bye) (*M* = 6.871) and DANKE (thank you) (*M* = 3. 613) which already shows a much lower mean iconicity rating than the first two signs. The other signs show a rating below 3 which is also taken as indication for non-obvious form-meaning mappings.

Table 10 below gives a summary of the descriptive values in each lexical class and again shows that on a 7-point Likert scale, common conversational elements showed the highest mean iconicity rating, followed by verbs, nouns, adjectives and adverbs. Figure 27 below illustrates the distribution of iconicity rating in each lexical class in violin-boxplots.

Table 10 | *Descriptive Statistics of each Lexical Class*

	Noun	Verb	Adjective	Adverb	Conversational Element
Number of Ratings	146	145	23	8	6
Mean	3.509	3.945	3.027	2.837	4.183
Std. Deviation	1.650	1.516	1.622	1.009	2.187
Minimum	1.105	1.474	1.368	1.625	2.097
Maximum	6.711	6.848	6.771	4.548	7.000

Figure 27 | *Violin-Boxplot Illustration of Mean Iconicity Distribution in Each Lexical Class*



Note. For each lexical class (noun, verbs, conversational element, adjective and adverb) a violin boxplot is displayed indicating the mean iconicity distribution per lexical class. The boxplot displays the median (bold black line) of iconicity ratings within each lexical class, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

Across the whole sample, the most iconic signs are the signs for HALLO (hello), TSCHÜSS (bye), TRINKEN (to drink), SCHWIMMEN (to swim), SCHLAFEN (to sleep), WEINEN (to cry), STARK (strong), BABY (baby), IDEE (idea) and LANGSAM (slow) with an average iconicity rating above 6.6 whereas the signs for ONKEL (uncle), DVD (DVD), OPA (grandfather), WASSER (water), FRAU (woman), ALT (old), VATER (father), URLAUB (vacation), PFERD (horse) and PFLEGE (care) are rated as least iconic with an average rating below 1.4. Table 11 below shows the descriptive values for the ten ÖGS signs with the highest and the lowest iconicity rating in detail. What is striking is that among the ten most iconic signs, the most dominant lexical class are verbs whereas no adverb is among the most iconic signs (in fact, among the 100 most iconic signs no adverb is included). Among the ten least iconic signs are mainly and almost exclusively nouns. However, nouns (together with verbs) make up the majority of signs.

Table 11 | *Descriptive Statistics for the Signs with the Highest and Lowest Mean Iconicity Rating Across All ÖGS Signs*

ÖGS Sign	English Translation	Lexical Class	Mean	SD	Mode	Minimum	Maximum	Number of Ratings
HALLO	Hello	Conversational Element	7,000	0	7	7	7	22
TSCHÜSS (ABSCHIEDSGRUSS)	Bye	Conversational Element	6,871	0,562	7	4	7	31
TRINKEN	drink	Verb	6,848	0,619	7	1	7	151
SCHWIMMEN	swim	Verb	6,836	0,526	7	3	7	146
SCHLAFEN	sleep	Verb	6,801	0,701	7	3	7	146
WEINEN	cry	Verb	6,792	0,588	7	5	7	24
STARK	strong	Adjective	6,771	0,547	7	5	7	35
BABY	baby	Noun	6,711	0,515	7	5	7	38
IDEE	idea	Noun	6,694	0,577	7	5	7	36
LANGSAM	slow	Adjective	6,636	0,581	7	5	7	22
PFLEGE	care	Noun	1,389	0,599	1	1	3	36
PFERD	horse	Noun	1,375	0,647	1	1	3	24
URLAUB	holiday	Noun	1,375	1,013	1	1	5	24
VATER	father	Noun	1,375	0,711	1	1	4	24
ALT	old	Adjective	1,368	0,942	1	1	5	38
FRAU	woman	Noun	1,357	0,678	1	1	3	28
WASSER	water	Noun	1,290	0,588	1	1	3	31
OPA	grandfather	Noun	1,211	0,474	1	1	3	38
DVD	DVD	Noun	1,179	0,476	1	1	3	28
ONKEL	uncle	Noun	1,105	0,311	1	1	2	38

8.2 Inferential Statistics

In what follows the results of the inferential statistics will be presented.

8.2.1 Differences between Correct and Incorrect Stimuli

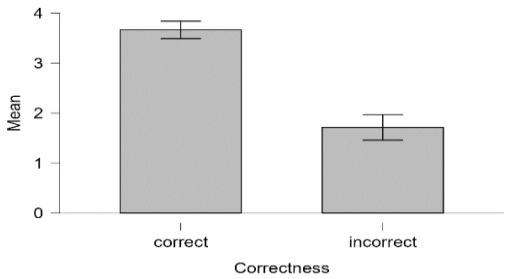
The Mann-Whitney U test[15] reveals that the mean of incorrect stimuli (M = 1.713, SD = 0.589, n = 23) and the mean of correct stimuli (M = 3.664, SD = 1.608, n = 328) significantly differ from each other (W = 6708.500 p <0.001), with correct signs being rated significantly higher for iconicity than incorrect signs. Table 12 below summarizes the descriptive values of correct and incorrect stimuli. Figure 28 illustrates the mean of correct and incorrect stimuli.

[15] The Shapiro-Wilk test does not show a normal distribution for the two groups of stimuli (correct: p <0.001, incorrect: p = 0.003) which is why a nonparametric alternative to the independent samples t-test is used.

Table 12 | *Descriptive Statistics of Correct and Incorrect Stimuli*

	correct	incorrect
Number of Ratings	328	23
Missing	0	0
Mean	3.664	1.713
Std. Deviation	1.608	0.589
Minimum	1.105	1.000
Maximum	7.000	3.154

Figure 28 | *Illustration of the Mean Iconicity Ratings of Correct and Incorrect Stimuli*



Note. The left bar represents the mean of correct stimuli, and the right bar represents the mean of incorrect stimuli.

Comparable results are reported by Caselli et al. (2017) and were interpreted as evidence that participants' rating is valid. Therefore, it is assumed that participants made reliable choices regarding the iconicity ratings for ÖGS signs in the present study. However, it is to note that these results should be treated with caution as the dataset is not balanced, and the group of incorrect stimuli is more than ten times smaller (n= 23) than the correct stimuli (n = 328). Nonetheless, this procedure was also applied by Caselli et al. (2017) and taken as indication that participants made rational choices concerning the iconicity rating.

8.2.2 Lexical Class: Difference in Iconicity Rating between Verbs and Nouns

On the descriptive level, the mean iconicity rating for verbs (*M* = 3.945, *SD* = 1.515, range = 1.474-6.848, n =145) is higher than for nouns (*M* = 3.509, *SD* = 1.605, range= 1.105-6.711, n=146) (see Table 13). Figure 29 and Figure 30 illustrate the distribution of mean iconicity ratings in nouns and verbs, respectively. Figure 31 depicts the distribution of mean iconicity ratings in nouns and verbs through a violin-boxplot.

Table 13 | *Descriptive Statistics of Iconicity Ratings in Verbs and Nouns*

	Noun	Verb
Valid	146	145
Mean	3.509	3.945
Std. Deviation	1.650	1.516
Shapiro-Wilk	0.927	0.947
P-value of Shapiro-Wilk	< .001	< .001
Minimum	1.105	1.474
Maximum	6.711	6.848

Figure 29 | *Distribution of Mean Iconicity Ratings in Nouns*

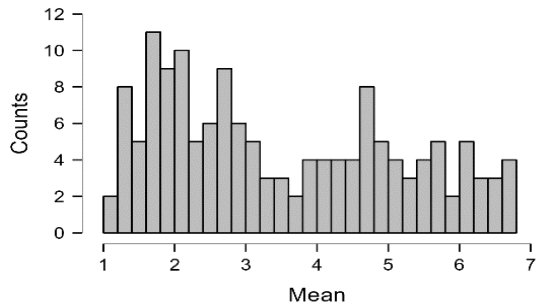
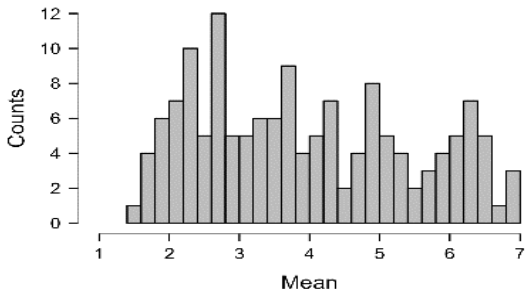
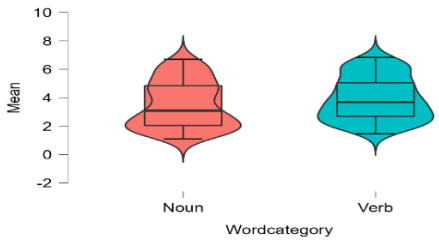


Figure 30 | *Distribution of Mean Iconicity Ratings in Verbs*



Note. The x-axis illustrates the mean from 1 to 7 in 0.2 steps, on the y-axis the number of signs for each mean value is depicted.

Figure 31 | *Violin-Boxplot of Iconicity Ratings in Nouns and Verbs*



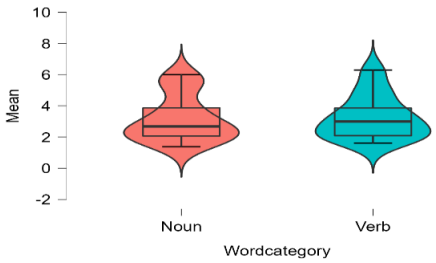
Note. For each lexical class (noun, verb) a violin boxplot is displayed indicating the mean iconicity distribution per lexical class. The boxplot displays the median (bold black line) of iconicity ratings within each lexical class, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

A Mann-Whitney U test [16] reveals that in this dataset verbs are rated significantly higher for iconicity than nouns (U= 8694.000, p = 0.004). Therefore, the first hypothesis that verbs are rated higher for iconicity than nouns can be supported.[17]

8.2.3 Homonyms: Differences between Homonym Verbs and Nouns

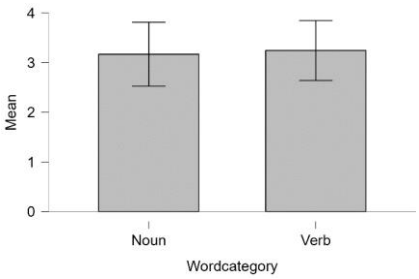
Regarding the difference within the set of homonyms, the Mann-Whitney U test[18] reveals no significant difference in the rating of nouns (homonym noun: M = 3.168, SD = 1.488, range = 1.389 – 6, n = 23) and verbs (homonym verb: M = 3.243, SD = 1.394, range = 1.605 – 6.308, n = 23) using the same sign (U = 247.00, p = 0.354). This means that within the set of homonyms, no effect of lexical class can be shown which means that in this set, verbs are not rated significantly higher for iconicity than nouns. The distribution of iconicity ratings in homonym nouns and verbs each is illustrated in Figure 32, and Figure 33 shows the mean iconicity rating of both homonym nouns and verbs.

Figure 32 | *Violin-Boxplot of the Iconicity Rating in Homonym Nouns and Homonym Verbs*



Note. For each lexical class (noun, verb) a violin boxplot is displayed indicating the mean iconicity distribution per lexical class. The boxplot displays the median (bold black line) of iconicity ratings within each lexical class, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

Figure 33 | *Illustration of the Mean Iconicity Ratings in Nouns and Verbs*



Note. The left bar depicts the mean of nouns, and the right bar represents the mean of verbs in the group of homonyms.

[16] The Shapiro-Wilk test shows that the data of both groups is not normally distributed (nouns: p < 0.001, verbs: p < 0.001).

[17] The analysis was also conducted with the sign GOTT (god) excluded, however, this had no effect on the results and still showed that verbs are rated significantly higher for iconicity than nouns (p = 0.004).

[18] The results of the Shapiro-Wilk test indicate no normal distribution for the results of the homonyms (nouns: p = 0.007, verbs: p = 0.024).

8.2.4 Semantic Category: Differences between Semantic Categories

In what follows the results of the analysis regarding semantic category will be presented.

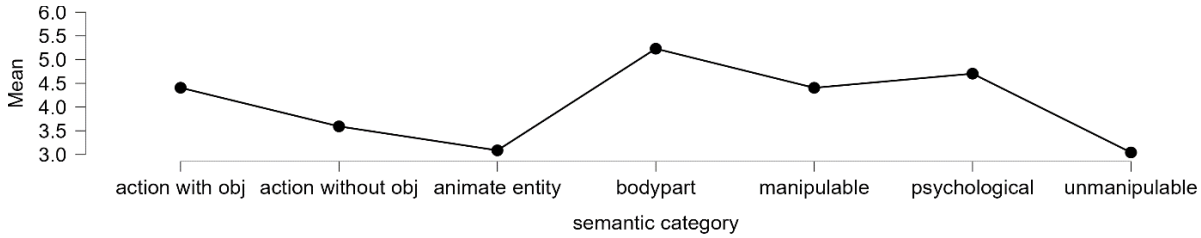
8.2.4.1 Analysis 1 (Two Additional Semantic Categories Body Parts and Psychological Signs Included)

In the first analysis, 290 signs are analyzed (action with obj.: n =50, action without obj.: n = 83, animate entity: n= 34, body parts: n = 3, manipulable object: n = 36, psychological: n =16, unmanipulable: n =68). The highest mean iconicity rating is shown by body parts (*M* = 5.229, *SD* = 0.987, range = 4.409 – 6.329) followed by psychological signs (*M* = 4.703, *SD* = 1.092, range =3.086 - 6.694), actions with object (*M* = 4.406, *SD* = 1.467, range = 1.474 – 6.848), manipulable objects (*M* = 4.405, *SD* = 1.803, range = 1.179- 6.608), actions without object (*M* = 3.592, *SD* = 1.522, range = 1.605 – 6.836), animate entities (*M* = 3.087, *SD* = 1.636, range = 1.105 – 6.608) and unmanipulable objects (*M* = 3.042, *SD* = 1.295, range = 1.209 – 6.00) (see Table 14). Figure 34 illustrates the mean iconicity rating of each semantic category to get a first impression which semantic categories show high and low iconicity ratings. Figure 35 illustrates the distribution of iconicity ratings in each semantic category through violin-boxplots.

Table 14 | *Descriptive Statistics of the Iconicity Rating in each Semantic Category- Analysis 1*

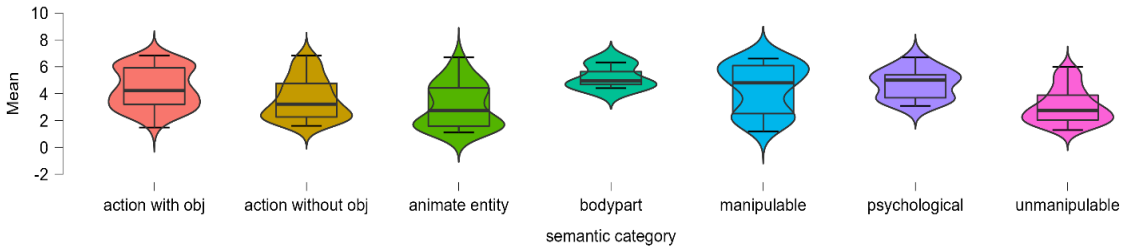
	action with obj.	action without obj.	animate entity	bodypart	manipulable obj.	psychological sign	unmanipulable obj.
Number of Ratings	50	83	34	3	36	16	68
Mean	4.406	3.592	3.087	5.229	4.405	4.703	3.042
Std. Deviation	1.467	1.522	1.636	0.987	1.803	1.092	1.295
Shapiro-Wilk	0.940	0.918	0.902	0.942	0.882	0.948	0.918
P-value of Shapiro-Wilk	0.013	< .001	0.005	0.535	0.001	0.455	< .001
Minimum	1.474	1.605	1.105	4.409	1.179	3.086	1.290
Maximum	6.848	6.836	6.711	6.324	6.608	6.694	6.000

Figure 34 | *Illustration of Mean Iconicity Rating in each Semantic Category – Analysis 1*



Note. For each semantic category (action with obj., action without obj., animate entity, body parts, manipulable obj., psychological signs and unmanipulable obj.) the mean iconicity rating is displayed.

Figure 35 | *Violin-Boxplot of Iconicity Ratings in each Semantic Category – Analysis 1*



Note. For each semantic category (action with obj., action without obj., animate entity, body parts, manipulable obj., psychological signs and unmanipulable obj.) a violin boxplot is displayed indicating the mean iconicity distribution per semantic category. The boxplot displays the median (bold black line) of iconicity ratings within each semantic category, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

A Kruskal-Wallis test [19] shows a significant effect of semantic category ($H(6) = 43.988$, $p < 0.001$). The Dunn's Post Hoc Comparisons reveal significant differences between action with object and animate entity ($p = 0.001$), action with object and unmanipulable objects ($p < 0.001$), animate entity and manipulable objects ($p = 0.010$), animate entity and psychological signs ($p = 0.005$), unmanipulable objects and manipulable objects ($p = 0.002$) and psychological signs and unmanipulable objects ($p = 0.002$). No significant differences are shown between the other semantic categories[20]. However, the

[19] The Shapiro-Wilk test shows no normal distribution for action with object ($p = 0.013$), action without object ($p < 0.001$), animate entity ($p = 0.005$), manipulable object ($p = 0.001$) and unmanipulable object ($p < 0.001$), and a normal distribution for psychological signs ($p = 0.455$) and body party ($p = 0.535$) which is why a nonparametric test is used.

[20] No significant differences are found between action with object, psychological signs, body parts and manipulable object or between unmanipulable object, animate entity and action without object.

uncorrected *p*-value also indicate significant differences between action with object and action without object ($p = 0.004$), action without object and manipulable object ($p = 0.023$), psychological signs ($p = 0.007$) and unmanipulable object ($p = 0.035$) as well as between body part and animate entity($p = 0.022$) and unmanipulable object ($p = 0.021$) The *p*-values for each Post Hoc Comparison can be seen in Table 1 in Appendix D.

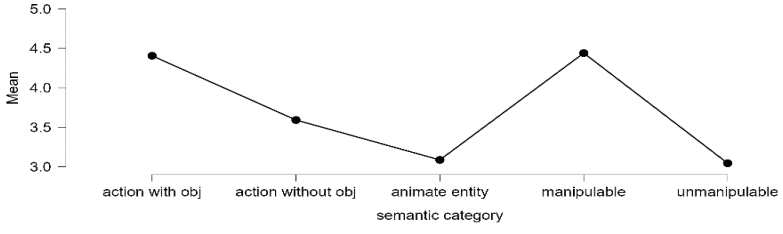
8.2.4.2 Analysis 2 (the Semantic Categories Body Parts and Psychological Signs Excluded)

The second analysis includes 271 signs (action with obj.: n = 50, action without obj: n = 83, animate entity: n = 34, manipulable object: n = 36, unmanipulable object: n = 68). The highest mean iconicity rating is shown by the semantic category action with object ($M = 4.406$, $SD = 1.467$, range = 1.474 – 6.848) followed by manipulable object ($M = 4.405$, $SD = 1.803$, range = 1.179- 6.608), action without object ($M = 3.592$, $SD = 1.522$, range = 1.605 – 6.836), animate entity ($M = 3.087$, $SD = 1.636$, range = 1.105 – 6.608) and unmanipulable object ($M = 3.042$, $SD = 1.295$, range = 1.209 – 6.00). These values are the same as in Analysis 1 and can be seen in Table 15. Figure 36 below illustrates the mean iconicity ratings of each semantic category next to each other.

Table 15 | *Descriptive Statistics of the Iconicity Rating in each Semantic Category- Analysis 2*

	action with obj.	action without obj.	animate entity	manipulable obj.	unmanipulable obj.
Number of Ratings	50	83	34	36	68
Mean	4.406	3.592	3.087	4.405	3.042
Std. Deviation	1.467	1.522	1.636	1.803	1.295
Shapiro-Wilk	0.940	0.918	0.902	0.882	0.918
P-value of Shapiro-Wilk	0.013	< .001	0.005	0.001	< .001
Minimum	1.474	1.605	1.105	1.179	1.290
Maximum	6.848	6.836	6.711	6.608	6.000

Figure 36 | *Illustration of Mean Iconicity Rating in each Semantic Category – Analysis 2*



Note. For each semantic category (action with obj., action without obj., animate entity, manipulable obj. and unmanipulable obj.) the mean iconicity rating is displayed.

A Kruskal Wallis test[21] shows a significant effect of semantic category ($H(4) = 33.270$, $p < 0.001$). The Dunn's Post Hoc Comparisons reveal significant differences between action with object and action without object ($p = 0.023$), action with object and animate entity ($p < 0.001$), action with object and unmanipulable objects ($p < 0.001$), animate entity and manipulable objects ($p = 0.004$), unmanipulable objects and manipulable objects ($p = 0.001$). The uncorrected p-value for actions without object and manipulable objects ($p = 0.028$) and unmanipulable objects ($p = 0.035$) is significant as well. No significant differences are shown between actions with object and manipulable objects as well as between animate entities and unmanipulable objects. The p-values for each Post Hoc Comparison can be seen in Table 2 in Appendix D.

8.2.4.3 Short Summary

Descriptively, both analyses support the second subhypothesis, indicating that unmanipulable objects show the lowest mean iconicity rating. Regarding the first subhypothesis, Analysis 1 shows that the semantic categories body part and psychological sign show a higher mean iconicity rating than action with object. However, when psychological signs and body parts are excluded (Analysis 2), the semantic category action with object shows the highest mean iconicity rating. Therefore, only Analysis 2 supports the first subhypothesis.

Based on the results from the inferential statistics, both subhypotheses cannot be supported, however, the tests show some important tendencies. In both analyses, no significant differences are found between the semantic categories rated highest for iconicity - action with object, manipulable object and psychological signs and body parts. However, all these semantic categories significantly differ from the semantic categories with the lowest rating - unmanipulable object and animate entities[22]. So, based on the inferential statistics, there is no semantic category that is significantly rated higher or lower for iconicity than all other semantic categories. Instead, it seems to be the case that there are two

[21] The Shapiro-Wilk test shows no normal distribution for action with object ($p = 0.013$), action without object ($p < 0.001$), animate entity ($p = 0.005$), manipulable object ($p = 0.001$) and unmanipulable object ($p < 0.001$) which is why a nonparametric test is used.

[22] For body parts, the difference to the groups unmanipulable object and animate entity is only significant if the uncorrected p-value is considered.

extremes: semantic categories with high iconicity ratings (action with object, manipulable object, psychological sign (and body parts[23]) and semantic categories with low iconicity ratings (animate entity and unmanipulable objects). The semantic category action without object seems to lie between these extremes (as suggested by the uncorrected *p*-values from both analyses, indicating that actions without objects are rated significantly higher for iconicity than unmanipulable objects but lower than manipulable objects and psychological signs).

To sum up, the results suggest that unmanipulable objects and animate entities both show the lowest mean iconicity rating, implying that these two semantic categories together are rated lowest for iconicity, whereas the group of actions with objects and manipulable objects and psychological signs (and body parts) are rated highest for iconicity. Note here that these results need to be treated with caution as the sample sizes are very small, nonetheless, they point to interesting patterns in the distribution of mean iconicity ratings that should be subject of future investigation.

8.2.5 Strategy of Iconicity: Differences between Iconic Strategies

In what follows the results of the analysis regarding strategy of iconicity will be presented.

8.2.5.1 Analysis 3 (Signs with an Average Iconicity Rating below 4 excluded)

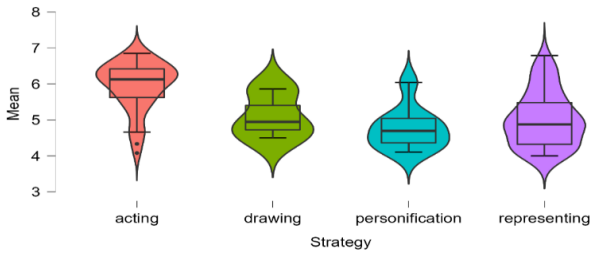
In this analysis, 110 signs are analyzed and include 41 *acting* signs, 3 *drawing* signs, 9 *personification* signs and 57 *representing* signs. *Acting* signs show the highest iconicity rating on average (M = 5.946, SD = 0.686, range =4.079 – 6.848), followed by *drawing* (M = 5.103, SD = 0.694, range = 4.500 – 5.861), *representing* (M = 5.016, SD = 0.758, range = 4 – 6.792) and *personification* (M = 4.749, SD = 0.592, range = 4.105 – 6.792) (see Table 16). Figure 37 below shows the distribution of iconicity ratings each strategy in a violin boxplot.

[23] Note here that the results for the semantic category body parts should be treated with special caution because this group only consist of three items.

Table 16 | *Descriptive Statistics of Iconicity Ratings in each Strategy of Iconicity – Analysis 3*

	acting	drawing	personification	representing
Number of Ratings	41	3	9	57
Mean	5.946	5.103	4.749	5.016
Std. Deviation	0.686	0.694	0.592	0.758
Shapiro-Wilk	0.904	0.962	0.893	0.939
P-value of Shapiro-Wilk	0.002	0.626	0.213	0.007
Minimum	4.079	4.500	4.105	4.000
Maximum	6.848	5.861	6.041	6.792

Figure 37 | *Violin-Boxplots of Iconicity Ratings in each Strategy of Iconicity – Analysis 3*



Note. For each strategy of iconicity (acting, drawing, personification and representing.) a violin boxplot is displayed indicating the mean iconicity distribution per strategy of iconicity. The boxplot displays the median (bold black line) of iconicity ratings within each strategy of iconicity, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

A Kruskal-Wallis test[24] reveals a significant effect of strategy ($H(3) = 32.260$, $p < 0.001$). The Dunn's Post Hoc Comparisons indicate significant differences in the rating between *acting* signs and *personification* signs ($p < 0.001$) and *acting* signs and *representing* signs ($p < 0.001$). Between the strategies *drawing*, *representing* and *personification* no significant differences are found. The results from the Post Hoc Comparison can be seen in Table 3 in Appendix D.

8.2.5.1.1 Nouns in Analysis 3 (Signs with an Average Iconicity Rating below 4 excluded)

The set of nouns in this analysis encompasses 52 signs. On the descriptive level, nouns with the *acting* strategy are rated highest for iconicity ($M = 5.916$, $SD = 0.621$, range =4.692 – 6.711, n = 16) followed by *drawing* signs ($M = 5.103$, $SD = 0.694$, range = 4.500 – 5.861, n = 3), *representing* signs ($M =$

[24] A Shapiro-Wilk test shows that the data is not normally distributed for *acting* ($p = 0.002$) and *representing* ($p = 0.006$) whereas the data for *drawing* ($p = 0.626$) and *personification* ($p = 0.213$) is normally distributed which is why a nonparametric test is used.

5.038, *SD* = 0.770, range = 4 – 6.556, n = 24) and *personification* signs (*M* = 4.749, *SD* = 0.592, range= 4.105 – 6.041, n= 9) (see Table 17).

Table 17 | *Descriptive Statistics of Iconicity Rating in Nouns- Analysis 3*

	acting	drawing	personification	representing
Number of Ratings	16	3	9	24
Mean	5.916	5.103	4.749	5.038
Std. Deviation	0.621	0.694	0.592	0.770
Shapiro-Wilk	0.925	0.962	0.893	0.947
P-value of Shapiro-Wilk	0.206	0.626	0.213	0.231
Minimum	4.692	4.500	4.105	4.000
Maximum	6.711	5.861	6.041	6.556

A Kruskal-Wallis test[25] shows a significant difference between the strategies of iconicity ($H(3) = 15.586$, $p = 0.001$). The Dunn's Post Hoc Test only shows a significant difference between *acting* and *representing* signs ($p = 0.004$) and *acting* and *personification* signs ($p = 0.004$). The results from the Post Hoc Comparisons can be seen in Table 4 in Appendix D.

8.2.5.1.2 Verbs in Analysis 3 (Signs with an Average Iconicity Rating below 4 excluded)

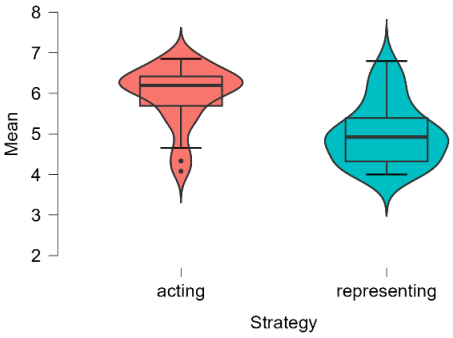
In the group of verbs, 58 signs are included (*acting*: n = 25 and *representing*: n = 33). *Acting* signs show a higher mean iconicity rating (*M* = 5.965, *SD* = 0.736, range = 4.079 – 6.848) compared to *representing* signs (*M* = 5.001, *SD* = 0.761, range = 4 – 6.792) (see Table 18). Figure 38 below illustrates the distribution of iconicity ratings in the two strategies in the group of verbs through a violin boxplot.

[25] According to the Shapiro Wilk test, the data for the strategies is normally distributed (*acting*: $p = 0.206$, *drawing*: $p = 0.626$, *representing*: $p = 0.231$, *personification*: $p = 0.213$), however, because of the small sample size of *drawing* and *personification* signs a nonparametric test is used. Note here, that as control an ANOVA is conducted that shows the same effects for strategies ($p < 0.001$).

Table 18 | *Descriptive Statistics of iconicity Rating in Verbs- Analysis 3*

	acting	representing
Number of Ratings	25	33
Mean	5.965	5.001
Std. Deviation	0.736	0.761
Shapiro-Wilk	0.870	0.931
P-value of Shapiro-Wilk	0.004	0.037
Minimum	4.079	4.000
Maximum	6.848	6.792

Figure 38 | *Violin-Boxplot of Iconicity Ratings in Verbs- Analysis 3*



Note. For the strategy of iconicity (acting and representing) a violin boxplot is displayed indicating the mean iconicity distribution per strategy of iconicity. The boxplot displays the median (bold black line) of iconicity ratings within each strategy of iconicity, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

A Mann-Whitney U test[26] shows a significant difference of mean iconicity ratings depending on strategy of iconicity in the group of verbs (U = 669.500, p <0.001) supporting the subhypothesis H2b that *acting* signs in the group of verbs are rated highest for iconicity.

8.2.5.2 Analysis 4 (Two Additional Strategies of Iconicity Metaphorical and Direct Referencing Included)

In Analysis 4, the sample includes 188 signs (*acting*: n = 54, *drawing*: n = 7, *metaphorical*: n = 16, *representing*: n = 96, *personification*: n = 12 and *direct referencing*: n = 3). 102 signs could not be assigned to a strategy and are thus excluded from the analysis. According to the mean, *acting* signs are rated highest for iconicity (M = 5.261, SD = 1.387, range = 2.211 – 6.848), followed by *direct referencing* signs (M = 5.229, SD = 0.987, range = 4.409 – 6.324), *metaphorical* signs (M = 4.703, SD = 1.092, range = 3.086 – 6.694), *personification* signs (M = 4.260, SD = 1.102, range = 1.684 – 6.041), *representing* signs (M = 4.222, SD = 1.181, range = 1.375 – 6.792) and *drawing* signs (M = 3.789, SD = 1.415, range = 2.056 – 5.861). As comparison, signs belonging to the category "no strategy" show the lowest mean iconicity

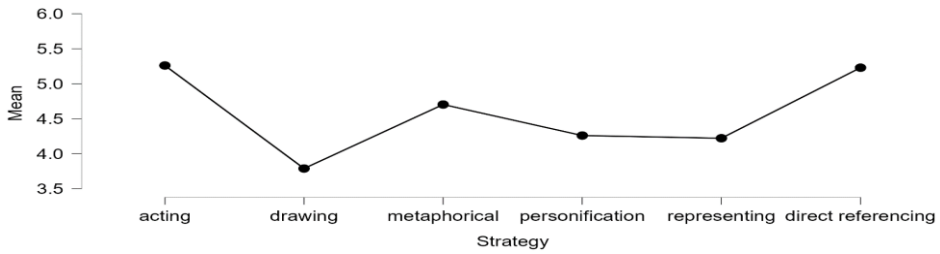
[26] The Shapiro-Wilk test showed that the data of the *acting* signs (p = 0.004) and *representing* signs (p = 0.037) is not normally distributed, which is why a nonparametric test was chosen.

rating by far (M = 2.175, SD = 0.608, range = 1.105 – 4.083) (see Table 19). Figure 39 below illustrates the mean iconicity rating of each strategy next to each other and Figure 40 depicts the distribution of iconicity ratings in each strategy.

Table 19 | *Descriptive Statistics of Iconicity Ratings in each Strategy of Iconicity – Analysis 4*

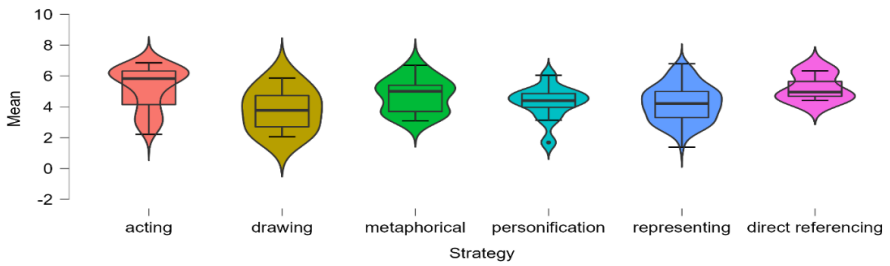
	acting	drawing	metaphorical	personification	representing	direct referencing
Number of Ratings	54	7	16	12	96	3
Mean	5.261	3.789	4.703	4.260	4.222	5.229
Std. Deviation	1.387	1.415	1.092	1.102	1.181	0.987
Shapiro-Wilk	0.859	0.955	0.948	0.932	0.987	0.942
P-value of Shapiro-Wilk	< .001	0.777	0.455	0.405	0.477	0.535
Minimum	2.211	2.056	3.086	1.684	1.375	4.409
Maximum	6.848	5.861	6.694	6.041	6.792	6.324

Figure 39 | *Illustration of Mean Iconicity Rating in each Strategy of Iconicity- Analysis 4*



Note. For each strategy of iconicity (acting, drawing, metaphorical personification, representing and direct referencing.) the mean iconicity rating per strategy of iconicity is illustrated.

Figure 40| *Violin-Boxplot of Iconicity Rating in each Strategy of Iconicity - Analysis 4*



Note. For each strategy of iconicity (acting, drawing, metaphorical personification, representing and direct referencing.) a violin boxplot is displayed indicating the mean iconicity distribution per strategy of iconicity. The boxplot displays the median (bold black line) of iconicity ratings within each strategy of iconicity, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

A Kruskal-Wallis test[27] reveals a significant effect of strategy ($H(5) = 25.432$, $p < 0.001$). According to the Dunn's Post Hoc Comparison, the only significant difference can be found between *acting* and *representing* signs, with *acting* signs being rated significantly higher for iconicity than *representing* signs ($p < 0.001$). The uncorrected *p*-value for the difference between *acting* and *drawing* ($p = 0.007$) and *acting* and *personification* ($p = 0.021$) is significant as well (the results of the Dunn's Post Hoc Comparison can be seen in Table 5 in Appendix D).

8.2.5.2.1 Nouns in Analysis 4 (Two Additional Strategies of Iconicity Metaphorical and Direct Referencing Included)

The set of nouns in this analysis encompasses 91 signs. On the descriptive level, nouns with the *direct referencing* strategy are rated highest for iconicity ($M = 5.229$, $SD = 0.987$, range =4.409 – 6.324, n = 3) followed by *metaphorical* signs ($M = 5.404$, $SD = 1.177$, range =3.875 – 6.694, n = 4), acting signs ($M = 5.195$, $SD = 1.456$, range = 2.211 – 6.711, n = 21), *personification* signs ($M = 4.260$, $SD = 1.102$, range = 1.684 – 6.041, n = 12), *representing* signs ($M = 4.113$, $SD = 1.285$, range = 1.375 – 6.556, n = 42) and *drawing* signs ($M = 3.789$, $SD = 1.415$, range= 2.056 – 5.861, n= 7) (see Table 20).

Table 20 | *Descriptive Statistics of Iconicity Rating in Nouns – Analysis 4*

	acting	drawing	metaphorical	personification	representing	direct referencing
Number of Ratings	21	7	4	12	42	3
Mean	5.195	3.789	5.404	4.260	4.113	5.229
Std. Deviation	1.456	1.415	1.177	1.102	1.285	0.987
Shapiro-Wilk	0.845	0.955	0.983	0.932	0.980	0.942
P-value of Shapiro-Wilk	0.003	0.777	0.917	0.405	0.647	0.535
Minimum	2.211	2.056	3.875	1.684	1.375	4.409
Maximum	6.711	5.861	6.694	6.041	6.556	6.324

[27] According to the Shapiro Wilk test, the data for most of the strategies is normally distributed (*drawing*: $p = 0.777$, *representing*: $p = 0.477$, *personification*: $p = 0.405$, *metaphorical*: $p = 0.455$, *direct referencing*: $p = 0.535$), however the data for the *acting* signs is not normally distributed ($p < 0.001$) which is why a nonparametric test is used.

A Kruskal-Wallis test[28] shows a significant difference between the strategies ($H(5) = 14.199$, $p = 0.014$). The Dunn's Post Hoc Test only shows a significant difference between *acting* and *representing* signs ($p = 0.031$). Note here, that the uncorrected p-value for the difference between *acting* and *drawing* ($p = 0.019$) and *acting* and *personification* ($p = 0.047$) is significant as well. The results from the Post Hoc Comparisons can be seen in Table 6 in Appendix D.

8.2.5.2.2 Verbs in Analysis 4 (Two Additional Strategies of Iconicity Metaphorical and Direct Referencing Included)

In the group of verbs, 99 signs are included that only use three strategies: *acting* (n = 33), *metaphorical* (n = 12) and *representing* (n = 54). *Acting* signs show the highest mean iconicity rating ($M = 5.302$, $SD = 1.363$, range = 2.696 – 6.848) followed by *metaphorical* signs ($M = 4.470$, $SD = 1.005$, range = 3.086- 6.057) and *representing* signs ($M = 4.306$, $SD = 1.099$, range = 2.278 – 6.792) (see Table 21).

Table 21 | *Descriptive Statistics of Iconicity Rating in Verbs – Analysis 4*

	acting	**metaphorical**	**representing**
Number of Ratings	33	12	54
Mean	5.302	4.470	4.306
Std. Deviation	1.363	1.005	1.099
Shapiro-Wilk	0.852	0.924	0.983
P-value of Shapiro-Wilk	< .001	0.316	0.621
Minimum	2.696	3.086	2.278
Maximum	6.848	6.057	6.792

A Kruskal-Wallis test[29] shows a significant difference of mean iconicity ratings depending on strategy of iconicity in the group of verbs ($H(2) = 12.186$, $p = 0.002$). The Dunn's Post Hoc Comparison

[28] According to the Shapiro Wilk test, only the data for *acting* signs is not normally distributed ($p = 0.003$). The data for the remaining strategies is normally distributed (*drawing*: $p = 0.777$, *representing*: $p = 0.647$, *personification*: $p = 0.405$, *metaphorical*: $p = 0.917$, *direct referencing*: $p = 0.535$), however, because the data for the *acting* signs is not normally distributed and the sample sizes are very small, a nonparametric test is used.

[29] The Shapiro-Wilk test shows that the data of the *acting* signs ($p < 0.001$) is not normally distributed, whereas the data for the *representing* signs ($p = 0.621$) and *metaphorical* signs ($p = 0.316$) is normally distributed which is why a nonparametric test is chosen.

reveals a significant difference between *acting* and *representing* signs (p = 0.002) and no significant difference between *acting* and *metaphorical* signs (p = 0.129) and *representing* and *metaphorical* signs (p = 0.658).

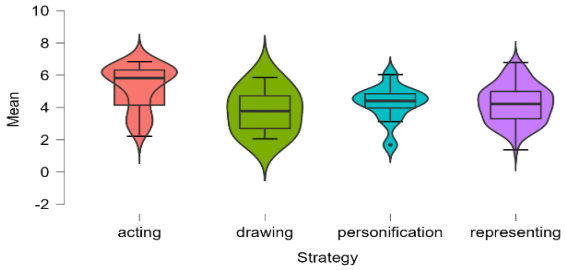
8.2.5.3 Analysis 5 (*Two Additional Strategies of Iconicity Metaphorical and Direct Referencing Excluded)*

In Analysis 5, the sample includes 169 signs (*acting*: n = 54, *drawing*: n = 7, *representing*: n = 96 and *personification*: n = 12). According to the mean, *acting* signs are rated highest for iconicity (M = 5.261, SD = 1.387, range = 2.211 – 6.848), followed by *personification* (M = 4.260, SD = 1.102, range = 1.684 – 6.041), *representing* (M = 4.222, SD = 1.181, range = 1.375 – 6.792) and *drawing* (M = 3.789, SD = 1.415, range = 2.056 – 5.861) (see Table 22). Figure 41 below illustrates the distribution of iconicity ratings in each strategy.

Table 22 | *Descriptive Statistics of Iconicity Ratings in each Strategy of Iconicity – Analysis 5*

	acting	drawing	personification	representing
Number of Rating	54	7	12	96
Mean	5.261	3.789	4.260	4.222
Std. Deviation	1.387	1.415	1.102	1.181
P-value of Shapiro-Wilk	< .001	0.777	0.405	0.477
Minimum	2.211	2.056	1.684	1.375
Maximum	6.848	5.861	6.041	6.792

Figure 41 | *Violin-Boxplot of Iconicity Rating in each Strategy of Iconicity– Analysis 5*



Note. For each strategy of iconicity (acting, drawing, personification and representing.) a violin boxplot is displayed indicating the mean iconicity distribution per strategy of iconicity. The boxplot displays the median (bold black line) of iconicity ratings within each strategy of iconicity, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

A Kruskal-Wallis test[30] reveals a significant effect of strategy ($H(3) = 23.263$, $p < 0.001$). According to the Dunn's Post Hoc Comparison, *acting* signs are rated significantly higher for iconicity than *representing* signs ($p < 0.001$) and *drawing* signs ($p = 0.040$). The difference between *acting* and *personification* signs is significant when considering the uncorrected p-value ($p = 0.024$), the corrected p-value is not significant ($p = 0.096$). The test shows no significant difference between the strategies *drawing, representing* and *personification*. The results of the Dunn's Post Hoc Comparison can be seen in Table 7 in Appendix D.

8.2.5.3.1 Nouns in Analysis 5 (Two Additional Strategies of Iconicity Metaphorical and Direct Referencing Excluded)

The set of nouns in this analysis encompasses 85 signs. On the descriptive level, nouns with the *acting* strategy are rated highest for iconicity ($M = 5.195$, $SD = 1.456$, range = 2.211 – 6.711, n = 21), followed by *personification* signs ($M = 4.260$, $SD = 1.102$, range = 1.684 – 6.041, n = 12), *representing* signs ($M = 4.113$, $SD = 1.285$, range = 1.375 – 6.556, n = 42) and *drawing* signs ($M = 3.789$, $SD = 1.415$, range = 2.056 – 5.861, n= 7) (see Table 23).

Table 23 | *Descriptive Statistics of Iconicity Rating in Nouns – Analysis 5*

	Acting	drawing	personification	representing
Number of Ratings	21	7	12	42
Mean	5.195	3.789	4.260	4.113
Std. Deviation	1.456	1.415	1.102	1.285
Shapiro-Wilk	0.845	0.955	0.932	0.980
P-value of Shapiro-Wilk	0.003	0.777	0.405	0.647
Minimum	2.211	2.056	1.684	1.375
Maximum	6.711	5.861	6.041	6.556

[30] According to the Shapiro Wilk test, the data for most of the strategies is normally distributed (*drawing*: $p = 0.777$, *representing*: $p = 0.477$, *personification*: $p = 0.405$, *metaphorical*: $p = 0.455$), however the data for the *acting* signs is not normally distributed ($p < 0.001$) which is why a nonparametric test is used.

A Kruskal-Wallis test[31] shows a significant difference between the strategies ($H(3) = 10.745$, $p = 0.013$). The Dunn's Post Hoc Test only shows a significant difference between *acting* and *representing* signs ($p = 0.015$). The uncorrected p-value for the comparison of *acting* and *drawing* signs is significant as well ($p = 0.020$) The results from the Post Hoc Comparisons can be seen in Table 8 in Appendix D.

8.2.5.3.2 Verbs in Analysis 5 (Two Additional Strategies of Iconicity Metaphorical and Direct Referencing Excluded)

In the group of verbs, 87 signs are included that belong to the *acting* (n = 33) and *representing* strategy (n = 54). *Acting* signs show the highest mean iconicity rating ($M = 5.302$, $SD = 1.363$, range = 2.696 – 6.848) followed by *representing* signs ($M = 4.306$, $SD = 1.099$, range = 2.278 – 6.792) (see Table 24).

Table 24 | *Descriptive Statistics of Iconicity Rating in Verbs – Analysis 5*

	acting	**representing**
Number of Ratings	33	54
Mean	5.302	4.306
Std. Deviation	1.363	1.099
Shapiro-Wilk	0.852	0.983
P-value of Shapiro-Wilk	< .001	0.621
Minimum	2.696	2.278
Maximum	6.848	6.792

A Mann-Whitney U test [32] shows a significant difference of mean iconicity ratings depending on strategy of iconicity in the group of verbs ($U = 1273.500$, $p < 0.001$) supporting the subhypothesis H2b that *acting* signs in the group of verbs are rated highest for iconicity.

[31] According to the Shapiro Wilk test, only the data for *acting* signs is not normally distributed ($p = 0.003$). The data for the remaining strategies is normally distributed (*drawing*: $p = 0.777$, *representing*: $p = 0.647$, *personification*: $p = 0.405$), however, because the data for the *acting* signs is not normally distributed, a nonparametric test is used.

[32] The Shapiro-Wilk test shows that the data of the *acting* signs ($p < 0.001$) is not normally distributed, whereas the data for the *representing* signs ($p = 0.621$) is normally distributed which is why a nonparametric test is chosen.

8.2.5.4 Short Summary

Taken together, all analyses show that *acting* signs have the highest mean iconicity rating descriptively (except for the group of nouns in Analysis 4 (set with metaphorical and direct referencing signs)) and therefore provide support for H2, H2a and H2b. Regarding inferential statistics, all analyses show that *acting* signs are rated significantly higher for iconicity than *representing* signs (these are the two biggest groups of strategies). According to Analysis 4 (set with metaphorical and direct referencing signs), there is no significant difference between *acting* signs and *metaphorica*l and *direct referencing* signs.

The analyses for the whole sample (verbs and nouns together) reveal different results in that Analysis 3 (all signs with a lower rating than 4 excluded) shows an additional significant difference between *acting* and *personification* signs and Analysis 5 (all signs are included that could be assigned to one of the four strategies, without metaphorical and direct referencing signs) shows a significant difference between *acting* and *drawing* signs. In Analysis 4 and 5, the uncorrected *p*-values also indicate significant differences between *acting* signs and the other two strategies *drawing* and *personification* which needs to be subject to future investigation to determine whether the effects can be replicated in a larger sample. Nonetheless, these results have to be treated with caution and are not enough evidence to support the second hypothesis.

Regarding nouns, all analyses (only) show a significant difference between *acting* and *representing* signs. It is to note that, in Analysis 4, the uncorrected *p*-value also indicates significant differences between *acting* signs and *drawing* and *personification* signs. Additionally, Analysis 4 shows that *acting* signs do not differ from *metaphorical* and *direct referencing* signs. So, these findings do not provide enough evidence to support H2a.

With regard to verbs, all analyses show that *acting* signs have the highest mean iconicity rating and are rated significantly higher for iconicity than *representing* signs. Analysis 4 shows no difference between *acting* and *metaphorical* signs. However, Analysis 3 and 5 (both analyses exclude metaphorical and direct referencing signs) show that *acting* signs are rated significantly higher for iconicity than the other signs (r*epresenting* signs) and, therefore, provide statistical evidence for H2b.

All in all, these analyses do not fully support all of the hypotheses, however, they provide important insights into the patterns of iconicity and reveal a tendency for *acting* signs to be among the group with the highest iconicity rating and to be rated significantly higher than *representing* signs.

8.2.6 Overall Summary

This section provides an overview over the main findings of the analyses regarding lexical class, semantic category and strategy of iconicity. Regarding differences in lexical classes, this master's thesis provides evidence for H1 and shows a significant difference in the rating of nouns and verbs, with verbs being rated significantly higher for iconicity than nouns. However, this difference is not shown in the set of homonym signs.

Regarding differences in semantic categories, descriptively, Analysis 1 (the two additional semantic categories body parts and psychological signs included) and Analysis 2(the two additional semantic categories body parts and psychological signs excluded) show that unmanipulable objects are rated lowest for iconicity which supports H1b. Additionally, descriptively, actions with objects show the highest mean iconicity rating when psychological signs and body parts are not considered, which is supporting H1a. However, the statistical evidence to support this claim is lacking. Nonetheless, these results provide useful insights into the patterns of iconicity and show a tendency that actions with objects (together with manipulable objects, psychological signs (and body parts)) are among the groups with the highest mean iconicity rating and are significantly more iconic than unmanipulable objects and animate entities. Therefore, H1a and H1b cannot be supported based on the results of the statistical analysis but these results are consistent with the weaker version of the hypotheses that unmanipulable objects tend to show a low iconicity rating and actions with objects tend to show high iconicity ratings.

Thirdly, regarding differences in strategies of iconicity, Analysis 3 (signs with a mean iconicity rating below 4 excluded), Analysis 4 (two additional strategies of iconicity metaphorical and direct referencing included) and Analysis 5(two additional strategies of iconicity metaphorical and direct referencing excluded) all show that *acting* signs have the highest mean iconicity rating (except for the group of nouns in Analysis 4) and thereby providing support for the hypothesis H2. Regarding inferential statistics, all analyses show that *acting* signs are rated significantly higher for iconicity than *representing* signs (Note here that these are the two biggest groups of strategies in the tested ÖGS sample). The overall analyses, considering both verbs and nouns, produce varying results. In Analysis 3 and 5 (both

analyses exclude metaphorical and direct referencing signs), some additional significant differences emerge, such as between *acting* and *personification* signs and between *acting* and *drawing* signs. Uncorrected *p*-values in Analysis 4 and 5 also indicate significant differences between *acting* signs and the other strategies, *drawing* and *personification*. However, these findings are not sufficiently strong to support the second hypothesis. When looking specifically at nouns, all analyses show a significant difference between *acting* and *representing* signs. Notably, Analysis 4's uncorrected *p*-values also indicate significant differences between *acting* signs and *drawing* and *personification* signs. Analysis 4, however, reveals that *acting* signs do not differ from *metaphorical* and *direct referencing* signs, thus failing to provide strong support for H2a. Turning to verbs, all the analyses consistently show that *acting* signs had the highest average iconicity ratings and are rated significantly higher for iconicity compared to *representing* signs. While Analysis 4 shows no distinction between *acting* and *metaphorical* signs, Analysis 3 and 5 offer statistical evidence for H2b, demonstrating that *acting signs* are rated significantly higher for iconicity than other signs, particularly *representing* signs. Taken together, the key findings from the analyses are:

- Verbs are more iconic than nouns.
- Actions with objects, manipulable objects, psychological signs (and body parts) tend to be more iconic than animate entities and unmanipulable objects.
- Acting sign are more iconic than representing signs.

Note here that these results need to be treated with caution as the sample sizes are very small and require future investigation. Particular caution is advised when interpreting the results related to the uncorrected *p*-values in the Post Hoc Comparison. These outcomes have not been adjusted for alpha error accumulation, posing a risk of erroneously identifying an effect. Nonetheless, these findings point to interesting patterns in the distribution of mean iconicity ratings and are the first to show effects of lexical class on the degree of iconicity, and possibly also effects of strategy of iconicity and semantic category on the degree of iconicity in a sign language! The question that thus arises is how those effects can be accounted for.

8.3 Exploratory Analysis

In what follows the results of the Exploratory Analysis will be presented.

8.3.1 Differences between Signs with Concrete and Abstract Meanings

In total, the 291 signs can be grouped into 107[33] (46 nouns, 61 verbs) signs with abstract meaning and 184 signs (100 nouns, 84 verbs) with a concrete meaning. According to the mean, concrete signs show a higher mean iconicity rating (M = 4.062, SD = 1.644, range = 1.105-6.848) than abstract signs (M = 3.136, SD = 1.332, range= 1.375-6.694) (see Table 25). A Mann-Whitney U test[34] shows a significant effect of concreteness (U= 6637.000, p <0.001) with concrete signs being more iconic than abstract signs.

Table 25 | *Descriptive Statistics of Iconicity Rating in Abstract and Concrete Signs*

	abstract	concrete
Number of Ratings	107	184
Mean	3.139	4.068
Std. Deviation	1.331	1.642
Minimum	1.375	1.105
Maximum	6.694	6.848

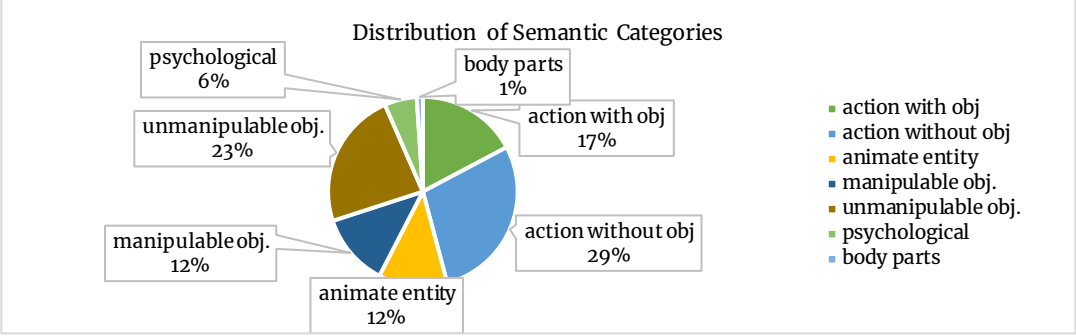
8.3.2 Relation between Lexical Class and Semantic Category

Across the whole sample of 290 ÖGS signs, 50 signs belong to the semantic category action with object, 83 signs are actions without object, 16 signs belong to the group psychological signs, 36 signs are manipulable objects, 34 signs belong to the group animate entity, 3 signs are body parts, and 68 signs belong to the group unmanipulable objects. Figure 42 below shows the percentual distribution of the semantic categories in the tested set of ÖGS signs. The two biggest groups are actions without objects and unmanipulable objects. The semantic categories action with objects, animate entity and manipulable object are roughly around the same size. The groups of psychological signs and body parts represent the smallest groups.

[33] The sign for GOTT (god) was included in this analysis.

[34] A Shapiro-Wilk test revealed no normal distribution of the data (abstract signs: p <0.001, concrete signs: p <0.001) which is why a nonparametric test was used.

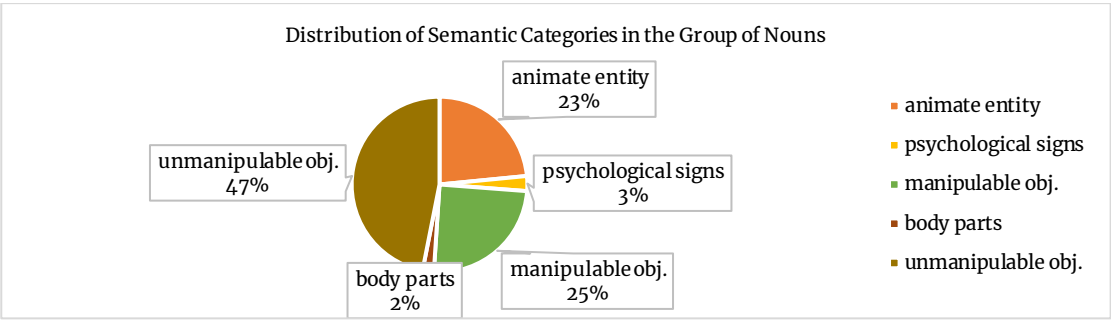
Figure 42 | *Pie Chart of the Distribution of Semantic Categories in Verbs and Nouns*



8.3.2.1 Distribution of Semantic Categories in Nouns

Within the group of nouns, the 145 nouns can be divided into 34 animate entities, 36 manipulable objects, 68 unmanipulable objects, 4 psychological signs and 3 body parts. The percentual distribution of each semantic category can be seen in Figure 43 below. Here, it is evident that almost half of the nouns belong to the semantic category unmanipulable objects. The group of animate entity and manipulable object are of similar sizes and represent a quarter of the signs. Psychological signs are the smallest group.

Figure 43 | *Pie chart of the Distribution of Semantic Categories in the Group of Nouns*



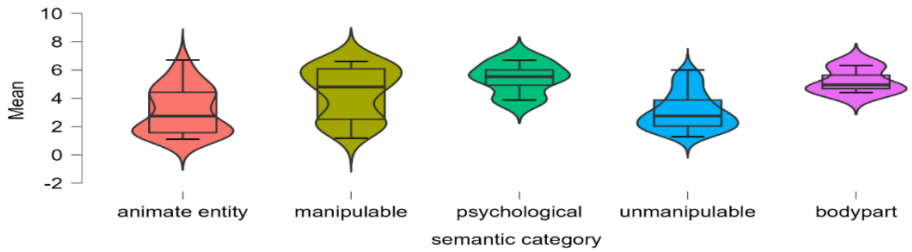
Descriptively, the group of psychological signs shows the highest mean iconicity rating (M = 5.404, SD = 1.177, range = 3.875 – 6.694) followed by body parts (M = 5.229, SD = 0.987, range = 4.409 - 6.324), manipulable objects (M = 4.405, SD = 1.803, range = 1.179 – 6.608), animate entities (M = 3.087, SD = 1.636, range = 1.105 - 6.711) and unmanipulable objects (M = 3.042, SD = 1.295, range = 1.290 –

6.00). (see Table 26). Figure 44 illustrates the distribution of iconicity ratings of nouns in each semantic category through a violin-boxplot.

Table 26 | *Descriptive Statistics of Iconicity Rating in each Semantic Category within the Set of Nouns*

	animate entity	manipulable object	psychological sign	unmanipulable object	body part
Number of Ratings	34	36	4	68	3
Mean	3.087	4.405	5.404	3.042	5.229
Std. Deviation	1.636	1.803	1.177	1.295	0.987
Shapiro-Wilk	0.902	0.882	0.983	0.918	0.942
P-value of Shapiro-	0.005	0.001	0.917	< .001	0.535
Minimum	1.105	1.179	3.875	1.290	4.409
Maximum	6.711	6.608	6.694	6.000	6.324

Figure 44| *Violin-Boxplot of Iconicity Rating in Semantic Category in the Group of Nouns*



Note. For each semantic category (action with obj., action without obj., psychological sign, unmanipulable obj. and body part) within the set of nouns a violin boxplot is displayed indicating the mean iconicity distribution. The boxplot displays the median (bold black line) of iconicity ratings within each semantic category, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

A Kruskal-Wallis[35] test shows a significant effect of semantic category in the group of nouns ($H(4) = 23.792$, $p < 0.001$) and the Dunn's Post Hoc Comparisons shows that manipulable objects differ significantly from animate entities ($p = 0.006$) and unmanipulable objects ($p = 0.004$). Between the groups manipulable object, psychological signs, and body parts no differences are found ($p = 1$ for each

[35] The Shapiro-Wilk test reveals no normal distribution of animate entity ($p = 0.005$), manipulable object ($p = 0.001$), unmanipulable object ($p < 0.001$) and a normal distribution for psychological signs ($p = 0.917$) and body parts ($p = 0.535$) which is why a nonparametric test is chosen.

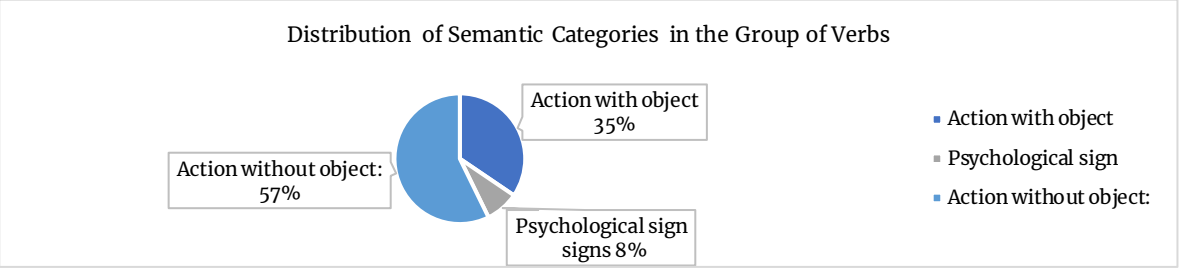
comparison). The uncorrected *p*-value, however, indicates further significant differences between semantic categories and shows that psychological signs and body parts each differ significantly from unmanipulable objects and animate entities (psychological signs – unmanipulable object: $p = 0.010$, psychological – animate entity: $p = 0.008$, body parts – unmanipulable object: $p = 0.036$, body part – animate entity: $p = 0.030$). The *p*-values of Dunn's Post Hoc Comparison can be seen in Table 9 in Appendix D.

The analysis for the sample without psychological signs and body parts yields identical results in that the Kruskal-Wallis test shows a significant effect of semantic category ($H(2) = 15.324$, $p<0.001$) as well, and the Dunn's Post Hoc Comparisons shows that manipulable objects are rated significantly higher for iconicity than unmanipulable objects ($p = 0.001$) and animate entities ($p = 0.001$) (see Table 10 in Appendix D).

8.3.2.2 Distribution of Semantic Category in Verbs

The group of 145 verbs can be divided into 50 actions with object, 12 psychological signs and 83 actions without object. The percentual distribution of each semantic category can be seen in Figure 45 below. Here, it is evident that the majority of verbs belong to the semantic category actions without object. The group of actions with object is the second largest group. Psychological signs are the smallest group.

Figure 45 | *Pie Chart of the Distribution of Semantic Categories in the Group of Verbs*

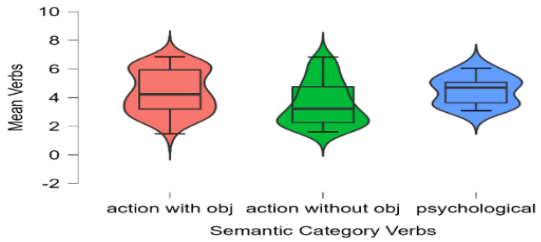


Descriptively, the group of psychological signs shows the highest mean iconicity rating ($M = 4.470$, $SD = 1.005$, range = 3.086 – 6.057) followed by actions with object ($M = 4.406$, $SD = 1.467$, range = 1.474 – 6.848) and actions without object ($M = 3.592$, $SD = 1.522$, range = 1.605 – 6.836) (see Table 27). Figure 46 depicts the distribution of iconicity ratings of verbs in each semantic category.

Table 27 | *Descriptive Statistics of Iconicity Rating in each Semantic category encompassing Verbs – Exploratory Analysis*

	action with obj	action without obj	psychological
Number of Ratings	50	83	12
Mean	4.406	3.592	4.470
Std. Deviation	1.467	1.522	1.005
Shapiro-Wilk	0.940	0.918	0.924
P-value of Shapiro-Wilk	0.013	< .001	0.316
Minimum	1.474	1.605	3.086
Maximum	6.848	6.836	6.057

Figure 46 | *Violin-Boxplot of Iconicity Rating in each Semantic Category Within the Group of Verbs*



Note. For each semantic category (action with obj., action without obj. and psychological sign) within the set of verbs, a violin boxplot is displayed indicating the mean iconicity distribution. The boxplot displays the median (bold black line) of iconicity ratings within each semantic category, along with the quartiles. The width of the violin indicates the density of iconicity ratings; hence, wider sections signify a higher prevalence of signs with corresponding mean iconicity ratings.

A Kruskal-Wallis[36] test shows a significant effect of semantic category in the group of verbs ($H(2) = 12.676$, $p = 0.002$) and the Dunn's Post Hoc Comparisons show that the semantic category action with object and psychological signs do not differ from each other ($p = 0.758$). This is also the case for psychological signs and actions without object ($p = 0.058$). The only significant difference is found between actions with object and actions without object ($p = 0.004$). The p-values of Dunn's Post Hoc Comparison can be seen in Table 11 in Appendix D. The analysis for the sample without psychological signs yields identical results in that the Mann-Whitney U test shows a significant difference between actions with object and actions without object ($U = 2765.5$, $p < 0.001$) with actions with object being rated significantly higher for iconicity than actions without objects

[36] The Shapiro-Wilk test does not reveal a normal distribution of action with object ($p = 0.013$), action without object ($p < 0.001$) and a normal distribution for psychological signs ($p = 0.316$) which is why a nonparametric test is chosen.

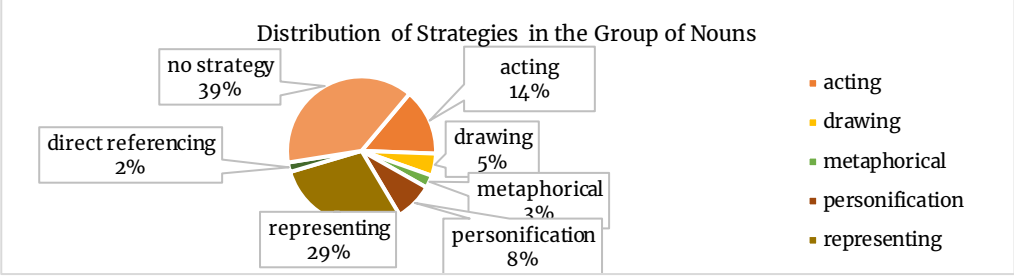
8.3.2.3 Short Summary

Taken together, the analyses of the semantic categories within the lexical classes verbs and nouns show that without considering psychological signs and signs for body parts, manipulable objects are rated highest for iconicity in nouns, and actions with object are rated highest for iconicity in verbs. If psychological signs (and body parts in case of nouns) are included in the analysis, then, these signs do not significantly differ from the group with the highest mean iconicity rating (manipulable objects in nouns and actions with object in verbs) which suggests that at least for the ÖGS signs tested in this master's thesis, psychological signs and signs for body parts belong to the signs with the highest mean iconicity rating. Note here, that the group of psychological signs is the only semantic group that encompasses both verbs and nouns.

8.3.3 Relation between Strategy of Iconicity and Lexical Class

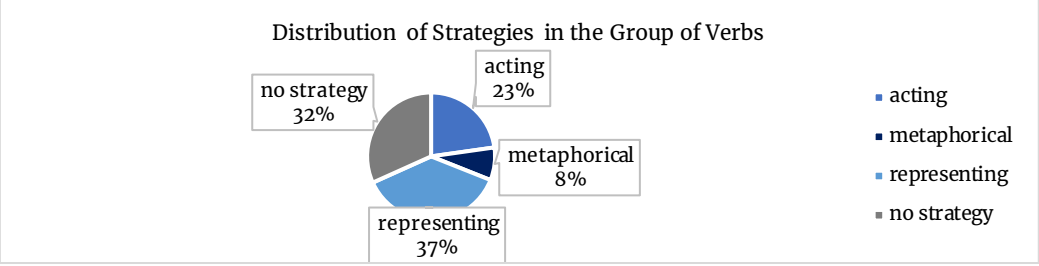
Regarding the relation between strategy of iconicity and lexical class, in the group of nouns, the most prominent strategy to depict meaning is *representing* (29 %), followed by the *acting* (14 %), *personification* (8 %) and *drawing* (5 %). 39 % of the signs could not be assigned to a strategy and are hence categorized as *no strategy*. The strategy *metaphorical* describes only a very small set of noun signs (3 %), similarly to the strategy *direct referencing* (2%). The distribution of strategies is illustrated in Figure 47 below.

Figure 47 | *Pie Chart of the Distribution of Strategies in the Group of Nouns*



In the group of verbs, the strategy *representing* is the most dominant strategy as well (37 %), followed by *acting* (23 %) and *metaphorical* (8 %). 32 % of the signs could not be assigned to a strategy (see Figure 48).

Figure 48 | *Pie Chart of the Distribution of the Strategies in the Group of Verbs*



A Mann-Whitney U test[37] shows that within the set of *acting* signs (21 nouns: M = 5.195, SD = 1.456, range = 2.211-6.711; 33 verbs: M = 5.302, SD = 1.363, range= 2.696-6.848), there is no significant difference between verbs and nouns (U= 323.5, p = 0.345). The same is shown in *representing* signs (nouns: M = 4.113, SD = 1.285, range= 1.375 - 6.556, n= 42; verbs: M = 4.306, SD = 1.099, range= 2.278 - 6.792, n= 54). Here, the Mann-Whitney U test shows that the rating of verbs and nouns does not differ as well (U = 1035, p = 0.212)[38]. This means, that if it is controlled for strategy of iconicity, then no effect of lexical class can be shown in this sample. These findings are in line with the results of the homonyms. Here, no effect of lexical class is present when nouns and verbs both belong to the same strategies. These results need to be treated with caution and require further investigation, nonetheless, they point towards the possibility that maybe in fact what drives this effect is strategy of iconicity and the effects shown for lexical class may only be a byproduct of the influence of strategy.

8.3.4 Relation between Strategy of Iconicity and Semantic Category

In the group of animate entities (n = 34), the most prominent strategy is *personification* (35%, n = 12) followed by *representing* (12%, n = 4) and *acting* (6 %, n = 2). 16 signs (47 %) could not be assigned to a strategy. The *personification* strategy is only found in animate entities. This distribution can be seen in Figure 49.

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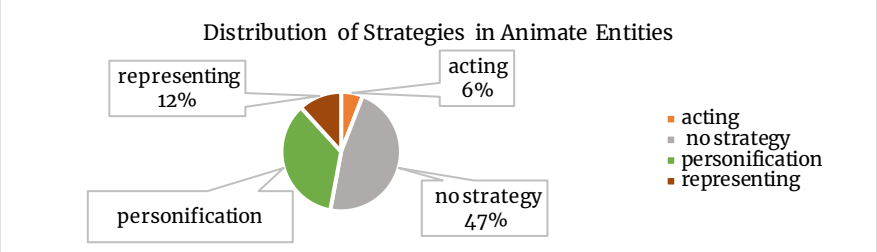
[37] A Shapiro-Wilk test does not show a normal distribution for *acting* signs (nouns: p = 0.003, verbs: p <0.001) which is why a nonparametric test is chosen.

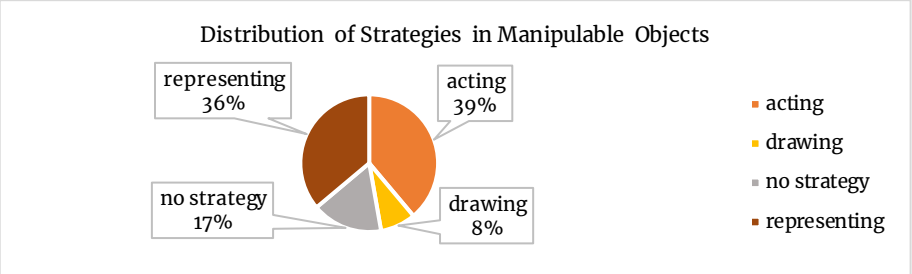
[38] The Shapiro-Wilk test for *representing* signs shows a normal distribution (nouns: p = 0.647, verbs: p = 0.621) but because of the small sample size a Mann-Whitney U- test as well as a parametric Student t-test are conducted. The Student t-test shows the same p-value (p = 0.233).

Figure 49 | *Pie Chart of the Distribution of Strategies in the Group of Animate Entities*



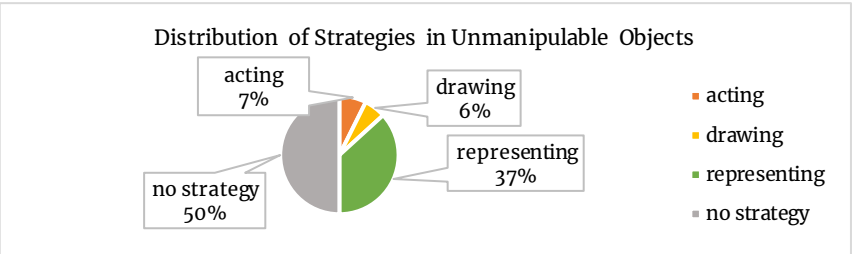
In the group of manipulable objects (n = 36), *acting* is the preferred strategy (39 %, n = 14), followed by *representing* (36 %, n = 13) and *drawing* (8 %, n = 3). 6 signs (17%) could not be assigned to a strategy. This distribution can be seen in Figure 50.

Figure 50 | *Pie Chart of the Distribution of Strategies in the Group of Manipulable Objects*



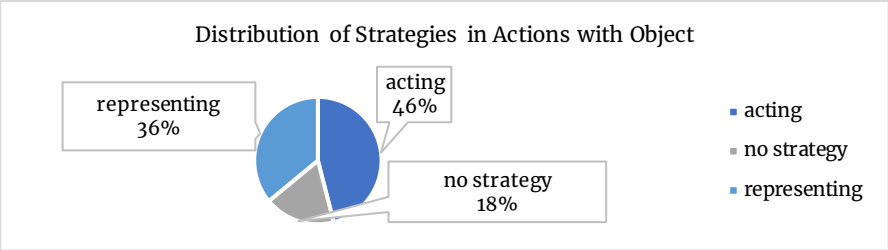
In the group of unmanipulable objects (n = 68), the preferred strategy is *representing* (37 %, n = 25) followed by *acting* (7 %, n = 5) and *drawing* (6 %, n = 4). 34 signs (50 %) belong to the category no strategy. This distribution can be seen in Figure 51.

Figure 51 | *Pie Chart of the Distribution of Strategies in the Group of Unmanipulable Objects*



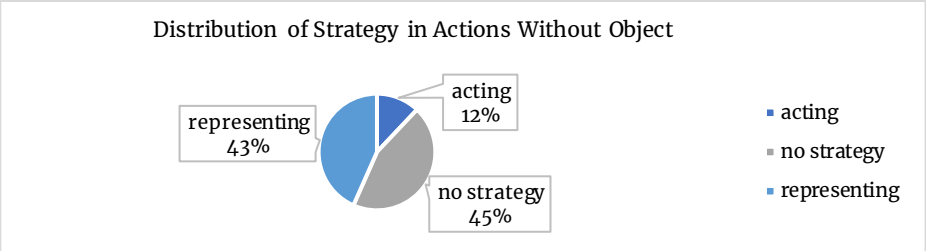
In the group of actions with object (n = 50), the most prominent strategy is *acting* (48 %, n = 23), followed by *representing* (34 %, n = 18). 9 signs (18%) could not be assigned to a strategy. This distribution can be seen in Figure 52.

Figure 52 | *Pie Chart of the Distribution of Strategies in Actions With Object*



In the group of actions without object (n = 83), the most frequent strategy is *representing* (43%, n = 36) followed by *acting* (12 %, n= 10). 37 signs (45%) show no strategy. This distribution can be seen in Figure 53.

Figure 53 | *Pie Chart of the Distribution of Strategies in Actions Without Object*



Note, the set of 12 psychological signs falls exclusively under the metaphorical strategy. Similarly, the three signs related to body parts are solely associated with the direct referencing strategy.

Table 28 provides a comprehensive overview of the absolute distribution of strategies within each semantic category and vice versa.

Table 28 | *Absolute Distribution of Semantic Categories and Strategies of Iconicity*

Semantic category	Strategy							
	acting	*represen-ting*	*drawing*	*personi-fication*	*meta-phorical*	*direct re-ferencing*	*no stra-tegy*	
Animate entity	2	4	0	12	0	0	16	**34**
Manipulable obj.	14	13	3	0	0	0	6	**36**
Unmanipulable obj.	5	25	4	0	0	0	34	**68**
Action with obj.	23	18	0	0	0	0	9	**50**
Action without obj.	10	36	0	0	0	0	37	**83**
Psychological signs	0	0	0	0	16	0	0	**16**
Body parts	0	0	0	0	0	3	0	**3**
	54	**96**	**7**	**12**	**16**	**3**	**102**	287

Note. In the column, the semantic categories are listed, while the lines display the corresponding strategies of iconicity. For every semantic category, it is indicated how many signs are assigned to each strategy of iconicity horizontally. For every strategy, the columns indicate how many signs form each semantic category are assigned to the respective strategy.

8.3.4.1 Effects of Semantic Category within Representing and Acting Signs

In the group of *acting* signs, one finds 23 actions with object (M = 5.174, SD = 1.369, range = 2.696-6.848), 10 actions without object (M = 5.598, SD = 1.371, range = 3.111 – 6.836), 2 animate entities (M = 6.240, SD = 0.666, range = 5.769 – 6.711), 14 manipulable objects (M = 5.460, SD = 1.340, range = 2.526 – 6.608) and 5 unmanipulable objects (M = 4.034, SD = 1.478, range = 2.211 – 5.737) (see Table 29).

Table 29 | *Descriptive Statistics of Iconicity Rating in Acting Signs*

	action with obj	action without obj	animate entity	manipulable	unmanipulable
Number of Ratings	23	10	2	14	5
Mean	5.174	5.598	6.240	5.460	4.034
Std. Deviation	1.369	1.371	0.666	1.340	1.478
Minimum	2.696	3.111	5.769	2.526	2.211
Maximum	6.848	6.836	6.711	6.608	5.737

A Kruskal-Wallis- test[39] does not reveal a significant effect of semantic category ($H(4) = 6.576$, $p = 0.160$). So, when it is controlled for strategy, no effect of semantic category can be found in *acting* signs.

Regarding the *representing* strategy, the sample includes 18 actions with object ($M = 4.269$, $SD = 1.086$. range = 2.658 – 6.316), 36 actions without object ($M = 4.325$, $SD = 1.121$, range = 2.278 – 6.792), 4 animate entities ($M = 3.175$, $SD = 1.443$, range = 1.375 – 4.607), 13 manipulable objects ($M = 4.699$, $SD = 1.457$, range = 2.105 – 6.556) and 25 unmanipulable objects ($M = 3.958$, $SD = 1.068$, range = 2.292 – 6.00) (see Table 30).

Table 30 | *Descriptive Statistics of Iconicity Rating in Representing Signs*

	action with obj	action without obj	animate entity	manipulable	unmanipulable
Number of Ratings	18	36	4	13	25
Mean	4.269	4.325	3.175	4.699	3.958
Std. Deviation	1.086	1.121	1.443	1.457	1.068
Shapiro-Wilk	0.957	0.986	0.955	0.921	0.954
P-value of Shapiro-Wilk	0.536	0.923	0.749	0.257	0.301
Minimum	2.658	2.278	1.375	2.105	2.292
Maximum	6.316	6.792	4.607	6.556	6.000

A Kruskal-Wallis- test[40] does not show a significant effect of semantic category in the *representing* signs ($H(4) = 5.611$, $p = 0.230$). Taken together, these results suggest that when it is controlled for strategy, no effect of semantic category is shown. Nonetheless, there could be various reasons why

[39] The Shapiro-Wilk test does not reveal normal distribution for actions with objects ($p = 0.004$), actions without objects ($p = 0.022$), animate entities (p-value not given because of small sample size) and manipulable objects ($p = 0.003$). Only for unmanipulable objects, the Shapiro-Wilk test shows a normal distribution ($p = 0.729$) which is why a nonparametric test is chosen.

[40] The Shapiro-Wilk test reveals normal distribution for actions with objects ($p = 0.536$), actions without objects ($p = 0.923$), animate entities ($p = 0.749$), manipulable objects ($p = 0.257$) and for unmanipulable objects ($p = 0.301$) which is why an ANOVA can be conducted. This ANOVA showed no effect of semantic category ($p = 0.145$). As a control and due to the very small sample size, a Kruskal-Wallis test is conducted as well.

no effect was shown, therefore, these results need to be treated with caution and require future research to disentangle the interaction between strategy of iconicity and semantic category.

8.3.4.2 Effects of Strategy of Iconicity within Semantic Categories

In what follows the results of the analysis regarding the distribution of strategy of iconicity in each semantic category will be presented.

8.3.4.2.1 Distribution of Strategy of Iconicity in Animate Entities

In the group of animate entities, the 2 *acting* signs show the highest mean iconicity rating (M = 6.240, SD = 0.666, range = 5.769-6.711), followed by 12 *personification* signs (M = 4.260, SD = 1.102. range = 1.684-6.041) and 4 *representing* signs (M = 3.175, SD= 1.443, range= 1.375-4.607) (see Table 31).

Table 31 | *Descriptive Statistics of Iconicity Ratings in Animate Entity*

	acting	personification	representing
Number of Ratings	2	12	4
Mean	6.240	4.260	3.175
Std. Deviation	0.666	1.102	1.443
P-value of Shapiro-Wilk	NaN	0.405	0.749
Minimum	5.769	1.684	1.375
Maximum	6.711	6.041	4.607

A Kruskal-Wallis test[41] shows a significant effect of strategy (H(1) = 2.485, p = 0.039) and the Dunn's Post Hoch Comparison shows a significant difference between *acting* and *representing* signs (p = 0.033). The results of the Dunn's Post Hoc Comparison are given in Table 12 in Appendix D. Due to the small sample size of *acting* signs, this analysis is repeated and excluded *acting* signs, however, a Student's t-test shows no difference between *representing* and *personification* signs (F(14) = 1.588, p = 0.135).

[41] A Shapiro-Wilk test shows a normal distribution for *representing* signs (p = 0.749) and *personification* signs (p = 0.405). No p-value is given for *acting* signs which is why a nonparametric test is used.

8.3.4.2.2 Distribution of Strategy of Iconicity in Manipulable Objects

In the group of manipulable objects, the 14 *acting* signs show the highest mean iconicity rating (*M* = 5.460, *SD* = 1.340, range = 2.526-6.608) followed by 13 *representing* signs (*M* = 4.699, *SD* = 1.457, range = 2.105-6.556) and 3 *drawing* signs (*M* = 3.394, *SD*= 1.457. range= 2.056-4.947) (see Table 32). A Kruskal-Wallis test[42] shows no significant effect of strategy ($H(2) = 4.829$, $p = 0.089$).

Table 32 | *Descriptive Statistics of Iconicity Rating in Manipulable Objects*

	Acting	drawing	representing
Number of Ratings	14	3	13
Mean	5.460	3.394	4.699
Std. Deviation	1.340	1.457	1.457
P-value of Shapiro-Wilk	0.003	0.755	0.257
Minimum	2.526	2.056	2.105
Maximum	6.608	4.947	6.556

8.3.4.2.3 Distribution of Strategy of Iconicity in Unmanipulable Objects

In the group of unmanipulable objects, the 4 *drawing* signs show the highest mean iconicity rating (*M* = 4.085, *SD* = 1.521, range = 2.211-5.861) followed by 5 *acting* signs (*M* = 4.034, *SD* = 1.478, range = 2.211–5.737) and 25 *representing* signs (*M* = 3.947, *SD*= 1.068, range =2.2092–6) (see Table 33). A Kruskal-Wallis test [43] shows no significant effect of strategy ($H(2) = 0.192$, $p = 0.924$). However, these results need to be treated with caution as the samples sizes vary and are generally speaking very small.

[42] A Shapiro-Wilk test reveals a normal distribution for *representing* signs ($p = 0.257$) and *drawing* signs ($p = 0.755$) but does not show a normal distribution for *acting* signs ($p = 0.003$) which is why a nonparametric test is used.

[43] A Shapiro-Wilk test shows a normal distribution for *acting* signs ($p = 0.729$), for *representing* signs ($p = 0.301$), and for *drawing* signs ($p = 0.990$) which is why an ANOVA could be applied. This ANOVA shows no effect of strategy ($p = 0.949$). Because of the small sample size an additional Kruskal-Wallis-test is used.

Table 33 | *Descriptive Statistics of Iconicity Rating in the Group of Unmanipulable Objects*

	acting	drawing	representing
Number of Ratings	5	4	25
Mean	4.034	4.085	3.958
Std. Deviation	1.478	1.521	1.068
P-value of Shapiro-Wilk	0.729	0.990	0.301
Minimum	2.211	2.211	2.292
Maximum	5.737	5.861	6.000

8.3.4.2.4 Distribution of Strategy of Iconicity in Actions Without Object

In the group of actions without object are 10 *acting* signs (M = 5.598, SD = 1.371, range = 3.111-6.836) that show the highest mean iconicity rating followed by 36 *representing* signs (M = 4.325, SD = 1.121, range = 2.278-6.792) (see Table 34). A Mann-Whitney U-test[44] shows a significant effect of strategy of iconicity (U = 122.000, p = 0.005) with *acting* signs being more iconic than *representing* signs within the semantic category action without object.

Table 34 | *Descriptive Statistics of Iconicity Rating in the Group of Actions Without Object*

	acting	representing
Number of Ratings	10	36
Mean	5.598	4.325
Std. Deviation	1.371	1.121
P-value of Shapiro-Wilk	0.022	0.923
Minimum	3.111	2.278
Maximum	6.836	6.792

8.3.4.2.5 Distribution of Strategy of Iconicity in Actions With Object

In the group of actions with object, the 23 *acting* signs show the highest mean iconicity ratings (M = 5.174, SD = 1.369, range = 2.696-6.848) followed by 18 *representing* signs (M = 4.269, SD = 1.086, range

[44] A Shapiro-Wilk test shows normal distribution for *representing* signs (p =0.923) but no normal distribution for *acting* signs (p = 0.022) which is why a nonparametric test is used.

= 2.658 – 6.316) (see Table 35). A Mann-Whitney U-test[45] shows a significant effect of strategy (U = 288.00, p = 0.017) with *acting* signs being more iconic than *representing* signs.

Table 35 | *Descriptive Statistics of Iconicity Rating in the Group of Action With Object*

	acting	representing
Number of Rating	23	18
Mean	5.174	4.269
Std. Deviation	1.369	1.086
P-value of Shapiro-Wilk	0.004	0.536
Minimum	2.696	2.658
Maximum	6.848	6.316

8.3.4.2.6 Short Summary.

Taken together, these results suggest that when it is controlled for semantic category, the effects of strategy of iconicity persist with *acting* signs showing the highest mean iconicity rating descriptively (with the exception of unmanipulable objects, here, the acting strategy only describes a very small amount of items). However, only in the two groups of actions, the difference between *acting* signs and *representing* signs is significant with *acting* signs being rated significantly higher for iconicity. For semantic categories encompassing nouns, this cannot be shown. Nonetheless, these results provide a first hint that maybe what drives the effects regarding the degree of iconicity is strategy of iconicity.

9 Discussion

In what follows, the primary findings obtained through the analyses of this master's thesis will be reviewed. Before the results of the analysis will be discussed in detail, it needs to be reiterated that all results should be interpreted with care. This master's thesis represents the first analysis for ÖGS and one of the first for sign languages in general that examines the relation between degree of iconicity and

[45] A Shapiro-Wilk test shows normal distribution for *representing* signs (p =0.536) but no normal distribution for *acting* signs (p = 0.004) which is why a nonparametric test is used.

other aspects such as strategy of iconicity, lexical class or semantic category. Towards the end of this section, important limitations as well as potential directions for future research will be addressed.

9.1 Differences in Lexical Class

The significant differences in mean iconicity rating between verbs and nouns found in Sehyr and Emmorey (2019) and Perlman et al. (2018) could be replicated for the ÖGS signs in this master's thesis. This raises the question of why verbs are perceived as more iconic than nouns. Perlman et al. (2018) argue that signs for actions may be more iconic than signs for things and objects because the production of signs is in itself an action and may thus be easier connected to the meaning of an action. Moreover, Perlman et al. (2018) suggest that nouns express more abstract meanings than verbs which may explain the finding that verbs are rated higher for iconicity than nouns. This assumption is supported by the Exploratory Analysis of this master's thesis inasmuch as it was shown that concrete meaning is rated significantly higher for iconicity than abstract meaning. Yet, the distribution of concrete and abstract meanings across the lexical classes verbs and nouns in the ÖGS sample challenges the assumptions made by Perlman et al. (2018) in that nouns do not tend to convey abstract meaning more often than verbs as the majority of signs belonging to the group of abstract meaning are, in fact, verbs. However, it was not controlled for to which degree the meaning is abstract or if some meanings are more abstract than other meanings, so it could be that the majority of signs with an abstract meaning are verbs, but nouns carry meanings that are even more abstract and difficult to depict than verbs' meanings. This assumption, however, needs further investigation. Moreover, it's important to acknowledge that determining whether a meaning is abstract or concrete can be a delicate task, and there may be instances where certain signs could reasonably fall into both categories based on respective arguments. As a result, it is advisable to approach these findings with caution.

However, the question remains inasmuch this difference between nouns and verbs is due to different lexical classes or if other aspects drive this effect. Counterintuitive in this regard is the finding from the set of homonyms. In the set of homonym signs that used the same sign (and thus the same strategy of iconicity) to express the noun and the verb (e.g., TRAUM (dream) and TRÄUMEN (to dream)), no difference in the rating of nouns and verbs could be shown. This of course could have various reasons (sample too small, bad examples etc.). However, this result stands against the assumption that the difference between nouns and verbs is due to their assignment to a lexical class. If degree of iconicity is influenced by lexical class alone (and not by strategy of iconicity or other aspects) and verbs

are more iconic than nouns, one would expect to find a higher iconicity rating for verbs if only signs belonging to the same strategy are compared. However, within the set of acting and representing signs, there is no significant difference between verbs and nouns. While these results should be approached cautiously and necessitate further investigation, they suggest the possibility that the driving force behind this effect could be the *strategy of iconicity*, with the effects observed in lexical classes possibly being a byproduct of this influence.

To explain the differences in lexical class, it was argued that signs more easily map onto the meaning of actions because signs are themselves actions (Perlman et al., 2018). This explanation could also be used to account for the fact that the acting strategy is the most iconic. Therefore, the distribution of strategies in the two lexical classes was analysed. Interestingly, from the 146 nouns in this master's thesis, 22 signs (15,06 %) are acting signs whereas from the 145 verbs, 34 signs (23,45 %, almost a quarter) belong to the acting signs. So, verbs show a higher percentage of acting signs. Furthermore, in the group of nouns, there are more types of strategies, whereas verbs usually only belong to the acting or representing strategy. Therefore, nouns have more "options" to encode meaning and create form-meaning mappings through the strategies used in this master's thesis or that more strategies are suitable to depict the meaning of nouns. It is essential to investigate whether the effects observed in the lexical classes are a consequence of the distribution of strategies and reflect only an effect of strategy.

9.2 Differences in Semantic Categories

Regarding the analysis of semantic category, the results from Ortega and Özyürek (2020) could be partly replicated. The results for unmanipulable objects in this set of ÖGS signs align with their findings, as these signs were rated as the least iconic. Concerning the most iconic semantic category, this analysis indicates that, descriptively, actions with objects have the highest mean iconicity rating (when psychological signs and body parts are excluded). This pattern can also be found in the results of Ortega and Özyürek (2020). However, here is to note that the group of manipulable objects showed almost identical values of mean iconicity rating. The inferential statistics in Analysis 1 and 2 both showed that unmanipulable objects together with the animate entities were rated significantly lower for iconicity than actions with object, manipulable objects (and when included psychological signs and body parts). The difference between unmanipulable objects and animate entities and body parts is only significant when the uncorrected *p*-value is considered. This may be due to the fact that only three signs belong to

the category body parts which is why further investigation is required to clarify if body parts in general are also a semantic category with high iconicity ratings.

While these findings do not entirely align with subhypotheses H1a and H1b, they do support a less restrictive version of these hypotheses, with unmanipulable objects and actions with objects being among the groups with the lowest and highest iconicity ratings, respectively. For the group of verbs, actions with object are rated significantly higher for iconicity than actions without objects. In the group of nouns, manipulable objects are rated significantly higher for iconicity than the categories animate entity and unmanipulable objects. However, when the set of psychological signs and body parts is included (in Analysis 1 for the whole sample as well as in the analysis for nouns and verbs each), these groups show the highest mean iconicity ratings and are rated higher for iconicity than manipulable objects (in nouns) and actions with object (in verbs). However, the difference between these categories is not statistically significant.

Regarding any observed differences between the study of Ortega and Özyürek (2020) and the present study, a few factors must be considered: firstly, the number of ÖGS signs in each category varies with some categories encompassing only a small set of signs which limits the reliability of the statistical results. Secondly, the semantic categories psychological signs as well as body parts (or the corresponding strategies metaphorical and direct referencing) are not used in the study of Ortega and Özyürek (2020) and are only used in this master's thesis which makes the comparison more difficult. What is even more important to keep in mind at this point is the fact that Ortega and Özyürek (2020) investigated silent gestures produced by non-signers whereas this master's thesis examines the iconicity of existing signs from a sign language. Therefore, the setting in the study of Ortega and Özyürek (2020) is different, because participants were forced to depict meaning and hence to create form meaning mappings, whereas in this master's thesis participants are asked to judge whether there even is a connection between form and meaning. Contrary to silent gestures, some signs do not show a link between form and meaning. For the ÖGS nouns and verbs analysed in this master thesis, 102 signs out of 290 signs (35%) show no obvious relation between form and meaning. Therefore, the fundamental question that arises here is inasmuch these results can be replicated for "real" language data. Nonetheless, the findings of this master's thesis are mostly in line with the results of Perlman et al. (2018) who found that in BSL and ASL signs belonging to the semantic categories *small artifacts* and *body parts and clothes* are rated highest for iconicity in the group of nouns, which is a similar pattern found in the ÖGS

set. Here, the manipulable objects which are similar to the group of small artifacts show a very high rating of mean iconicity as well. Additionally, the three ÖGS signs from the group of body parts KOPF (head), KÖRPER (body), HAND (hand) all show a very high mean iconicity rating and what is more, the two signs GÜRTEL (belt) and HANDSCHUH (glove) are even among the signs with the highest mean iconicity rating which is coherent with the results of Perlman et al. (2018). Nonetheless, as already mentioned, these assumptions, especially those regarding body parts, need future research to clarify the question which semantic categories tend to show a high degree of iconicity.

Coming back to the main findings of the analyses of semantic category, the question arises, why manipulable objects or actions with object might be perceived as more iconic than the other categories unmanipulable object and animate entity. Ortega and Özyürek (2020) showed that acting was the preferred strategy for actions with object, actions without object and manipulable objects, and that these signs within each semantic category were perceived as most iconic. To see if this pattern is also present in ÖGS signs and might be a reason for the high iconicity rating of actions with object and manipulable objects, the distribution of strategies in each semantic category is investigated in the Exploratory Analysis. Here, it is shown that this pattern can only partly be found in the ÖGS signs: Out of the 50 signs for actions with object, 23 (46 %) are acting signs and out of 36 manipulable objects, 14 (39 %) belong to the acting strategy whereas from the 83 signs for actions without object, only 10 (12 %) are assigned to the acting strategy , out of the 34 animate entities, 2 signs are acting signs (5 %) and out of the 68 unmanipulable objects, 5 signs are acting signs (7 %). So, in line with the finding of Ortega and Özyürek (2020), actions with object and manipulable objects show the highest percentage of acting signs and are rated higher for iconicity than the other semantic categories that show a much lower percentage of acting signs. Contrary to Ortega and Özyürek (2020), in the set of ÖGS signs, actions without object do not show the acting strategy as preferred strategy. This difference in distribution of the acting strategy could explain why actions without object in ÖGS are rated lower for iconicity than both actions with object and manipulable objects. However, this assumption needs further investigation. Regarding the question if the percentage or distribution of acting signs may explain the differences between semantic categories, the Exploratory Analysis shows that when it is controlled for semantic category, the effects of strategy persist in that descriptively acting signs show the highest mean iconicity rating in manipulable objects, actions with object, actions without object and animate entities but not in unmanipulable objects. Here, drawing signs show the highest mean iconicity rating. The pattern for unmanipulable objects is in line with the results of Ortega and Özyürek (2020) where they found that apart

for acting, drawing was one of the preferred strategies to depict the meaning of unmanipulable objects suggesting that maybe drawing is a strategy that is well suited to depict signs from this semantic category. However, inferential statistics showed that only in the two semantic categories encompassing actions, the difference in iconicity rating between acting and representing signs is statistically significant. This suggests that acting signs show a significantly higher iconicity rating than representing signs. This could not be shown for the semantic categories manipulable objects and unmanipulable objects. For animate entities, the test shows a significant difference between acting and representing signs, however, the group of acting signs only consists of two items which is why this result is treated as questionable. So, the results of the Exploratory Analysis show that the acting strategy might be a good predictor of degree of iconicity at least in actions. The effects of strategy within the semantic categories manipulable objects, unmanipulable objects and animate entities could not be observed. One possible explanation could be that nouns, in general, show a greater variety of strategies (at least with the use of these strategies in this ÖGS sample) which leads to signs being categorized into more groups with fewer signs in each group. As a result, the statistical analysis may lack the necessary statistical power. Therefore, further research is needed to determine if these results change when analysing a larger sample. Another potential reason for the lack of effects within the semantic categories, particularly for unmanipulable objects, could be that the acting strategy might not be ideal to depict the meaning of certain semantic categories such as unmanipulable objects. As the name of this category suggests, items of this group are either very big or abstract and, hence not manipulated by hands. For most unmanipulable objects, there may not be a clear and easily recognizable action associated with the referent which is why the acting strategy is not often found in unmanipulable objects. Additionally, regardless of strategy of iconicity, unmanipulable objects may be more difficult to depict manually than for instance manipulable objects. A similar challenge may exist for animate entities. In the ÖGS sample, most signs in this category emphasize the physical characteristics of the referent rather than specific actions associated with them, possibly because the meaning can more easily be recognised by depicting typical features or body parts of the referent. However, this assumption should be subject to future investigation. It needs further research as well to determine whether the absence of an effect of strategy of iconicity in manipulable objects is due to limited sample size or if, in reality, acting signs are not inherently more iconic than the other strategies (drawing, representing, personification).

The findings from the Exploratory Analysis for the group of actions with and without object are consistent with the finding of the analyses regarding strategy of iconicity that showed that in verbs,

acting signs in general show the highest mean iconicity rating and are significantly higher in iconicity than representing signs. This finding is in line with the findings of Sehyr and Emmorey (2019) as well who showed that handling signs (equivalent to acting signs) are rated higher for iconicity than entity signs (this set of signs more or less corresponds to what is called representing signs in the current master's thesis).

Taken together, these findings together with the findings of the analyses regarding strategy of iconicity showing that acting signs generally exhibit higher iconicity ratings and consistently surpass representing signs in iconicity across various analyses brings up the question why this might be the case.

9.3 Explanations for the Effects of Strategy of Iconicity

As a brief recap: The acting strategy describes signs in which the hands mimic any movements of the hand and therefore mime themselves, whereas in the representing strategy, the hands serve as representative of the referent by imitating the shape of the referent or parts of it (Müller, 2014; Ortega & Özyürek, 2020).

One explanation for the higher rating of acting signs can be found in Emmorey's approach of structure-mapping (2014). According to this view, the high iconicity rating of acting signs is a consequence of the high overlap between form and meaning. This means, that when participants rate the iconicity of ÖGS signs, they unconsciously compare the structure of the sign (the visual form) and the meaning or the mental representation that is associated with this meaning. The more correspondences are found, the more iconic the sign is perceived. Ortega et al. (2019) assume that participants rate acting signs as highly iconic because the depicted action closely aligned with their own mental representation of how that action is performed. This means that the execution of the sign corresponds more or less precisely to the movement that the person would perform if they were to carry out the actual action or the action associated with the referent which results into a one-to-one correspondence between form and meaning and thus a high iconicity. Sehyr and Emmorey (2019) argue furthermore that acting signs might be perceived as more iconic because non-signers could be influenced by their tendency to depict meaning through actions. This preference has as far as I know not been shown for Austrian non-signers, nonetheless, various studies come to uniform conclusions in this regard and show that non-

signers prefer the acting mode to depict meaning (e.g., Ortega & Özyürek, 2019; Padden et al., 2013) which is why this could as well be one explanation for the high rating of acting signs in the ÖGS sample.

At this point it is worth mentioning that in this master's thesis the investigation of the semantic category psychological signs or the corresponding metaphorical strategy yields interesting results. I know of no study that investigated the degree of psychological signs or the metaphorical strategy, so these results are the first of their kind and therefore need to be treated with special caution. Nonetheless, it is shown that psychological signs in this set of ÖGS signs show a comparatively high iconicity rating. To be exact, the group of psychological signs exhibits the highest iconicity rating in the analysis of semantic category (Analysis 1), however, according to inferential statistics, this semantic category does not differ from the semantic category action with object and manipulable object. In the analyses of strategy, it is shown that the metaphorical strategy also has comparatively high ratings of iconicity, and in the group of nouns, signs from the metaphorical strategy even show the highest mean iconicity rating. However, the results from inferential statistics suggest that the difference to the other strategies is not statistically significant. Nonetheless, the question arises why the signs from this semantic category or strategy of iconicity are easily connected to their meaning. Wilson and Gibbs (2007) examine the comprehension of metaphors in spoken language and show that both physically performing an action and mentally imagining performing it, can enhance the comprehension of metaphorical phrases related to those actions. For instance, the metaphor "grasp the concept" is understood faster if participants made a grasping movement in advance or just imagined grasping an object than when they had to perform no movement or a mismatching movement such as a pushing or chewing movement. Wilson and Gibbs (2007), thus, argue that the metaphorical body actions help participants to connect the metaphor to a concrete action and to understand the abstract concept as physical entity which facilitates their comprehension of metaphorical phrases. However, it is still a question for future investigation to determine inasmuch this argument is relevant for the effects observed in this master's thesis. Nonetheless, the results regarding psychological signs or the metaphorical strategy provide the first indication that these signs should get special attention in future research because this strategy shows a comparatively high degree of iconicity.

All explanations mentioned above trying to explain or account for effects of strategy of iconicity in some way align with the idea that linguistic processing is connected to body actions. Even when dealing

with abstract or physically impossible actions (as in the case of metaphors), people's embodied experiences play a role in understanding (Wilson & Gibbs, 2007).

With regard to the body parts or the strategy direct referencing, this master's thesis shows that direct referencing signs (or signs for body parts) exhibit high iconicity ratings. Here, it needs research to investigate if this group in general is perceived as highly iconic or if these three signs from the current master's thesis build an exception in this regard. To my knowledge, no study before has investigated the iconicity of what is called direct referencing signs in this master's thesis. However, if it is assumed that direct referencing signs are similar to pointing or deictic gestures in that both types of signs or gestures refer to objects or referents that are physically present (like body parts, or objects that are in close proximity) by directly shifting the addresses' attention to it (Taub, 2001), then the high iconicity ratings for these signs are not surprising given the fact that deictic gestures such as pointing have a special status in children's language development (Choi et al., 2021) and predict later vocabulary size. Pointing gestures are produced earlier than words (Özçalışkan et al., 2016) and signs (Morgenstern et al., 2010). However, not only infants use pointing gestures. Deictic gestures are an integral part of our every day's communication: What is special about pointing gestures is that they are themselves meaningless and can only be understood in the context of the situation which is why pointing can express a vast number of meaning (Tomasello et al., 2007). Therefore, future research is necessary to investigate the iconicity of deictic gestures or direct referencing signs. It would also be interesting to see if the high iconicity rating of body parts observed in this study reflects the high iconicity of direct referencing signs or if the semantic category body parts inherently is perceived as very iconic.

In summary, when considering the factors examined in this master's thesis that impact the degree of iconicity in ÖGS signs, the results demonstrate a clear effect related to lexical class and possibly an effect of semantic category and strategy of iconicity. Moreover, it was discussed that maybe the sign's strategy is a good predictor for the sign's iconicity. Nonetheless, it needs further research to investigate inasmuch one of these factors is more strongly indicative for the degree of iconicity. Ortega and Özyürek (2020) argue that for silent gestures both, the semantic category and the strategy, predict degree of iconicity, therefore, it will be subject to future research to determine in detail how these factors interact in ÖGS.

9.4 Limitations and Future Research

When it comes to evaluating the validity of this survey, it is essential to address some significant limitations. To begin with, it must be acknowledged that this survey was conducted online, and this approach brings its own advantages and disadvantages. On one hand, it allows for the rapid outreach to a large number of participants, but, on the other hand, it introduces several uncontrollable variables. Specifically, the online format makes it challenging to ensure that participants thoroughly read and comprehend the provided instructions and the nature of the task. Given that the rating of signs is inherently subjective and lacks clear right or wrong answers, assessing the validity becomes even more complex. To address this challenge, the survey incorporated videos of signs with a wrong translation and test stimuli that required participants to select a value of 5 (value-5-condition). These measures aimed to gauge whether participants attentively read the instructions presented alongside the videos, watched the videos, and made their assessments based on reasonable judgment.

Another aspect worth addressing is the *optimal* duration of an online experiment. It was tried to strike a balance, aiming to keep the survey as short as possible while still gathering a substantial amount of data. The questionnaires of this master's thesis encompass 94 or 93 stimuli for evaluation and typically take around 10 to 15 minutes to complete. Nevertheless, it is noteworthy that a significant number of participants did not complete the survey which might suggest that the questionnaire might have been too long, and it may be advisable to consider shortening it next time.

What is more, a lot of data was excluded because the test condition (the value-5-condition) was filled out incorrectly. If this question is filled out wrongly, it is assumed that participants did not read the instructions carefully which is why their ratings may be invalid. However, the question arises inasmuch it is important for this survey to read the instruction anew for every video because the instructions stay the same except for two test conditions in the whole questionnaire. This means, the task stays the same throughout the whole questionnaire and participants should do the same in every question. In light of this, it might be more appropriate to rely on incorrect stimuli exclusively to assess the validity of the ratings or participants' attention to their assessments. If incorrect stimuli do not yield significantly lower ratings than the correct stimuli, this could suggest that participants are not basing their decisions on an established form-meaning relationship. Another option would be to use a video for the test condition that differs more drastically from the other stimuli. In the present study, the video for the ÖGS sign TEST (test) was used as the test condition and looks exactly like the other

stimuli, featuring a person in the foreground signing something. Even the background color was the same as for most other videos. If a completely different video or maybe a picture would have been used where either the person is doing something else than signing or no person can be seen like a unicolored screen, it might have been easier for participants to recognize that this condition was different, and more participants may have answered this condition correctly.

With regard to the signs, some limitations need to be mentioned as well. At first, it needs to be mentioned that in this master's thesis the same categories and strategies analyzed by Ortega and Özyürek (2020) were used. However, these groups of semantic categories and strategies of iconicity were each expanded to include two additional groups (for semantic category the groups psychological signs and body parts were included, and for strategy of iconicity the metaphorical and direct referencing strategy were added) that have not been subject to this kind of research (at least to my knowledge). Moreover, in the study of Ortega and Özyürek (2020), silent gestures were examined that differ from signs of sign languages. Therefore, it needs to be questioned inasmuch these semantic categories or strategies of iconicity are appropriate for ÖGS signs. However, up to this day, it is the only study I know that examines the degree of iconicity and influencing factors such as strategy of iconicity or semantic category which is why the current master's thesis is based on the semantic categories and strategies of Ortega and Özyürek (2020).

One factor that needs to be highlighted at this point and that certainly influenced the results of the analyses was the assignment of ÖGS signs into the respective strategies of iconicity and into semantic categories. This decision is somewhat subjective and relies solely on the personal assessment of the author of this master's thesis. While efforts were made to maintain consistency and provide a rationale for assigning signs to the semantic categories and strategies of iconicity, it is possible that others might make different classifications (especially regarding the assignment to the strategy of iconicity), leading to potentially different outcomes. Therefore, it is intriguing to conduct further investigations on this topic to explore whether these results are replicable. Additionally, the categorization into strategies of iconicity or semantic categories resulted in unbalanced groups with different numbers of items belonging to the respective groups which limits the statistical validity of the analysis. Therefore, in future studies, it would be beneficial to work with groups that are more evenly sized to enhance the statistical robustness of the research. The results regarding the effects of semantic category and strategy of iconicity of this master's thesis should be treated with caution, however, they are the first (to the

best of my knowledge) that show significant effects of strategy, semantic category and lexical class on the degree of iconicity in a sign language.

These results not only contribute valuable insights into the iconicity of ÖGS signs but also serve as a foundational platform for future research. Subsequent investigations could aim to disentangle the intricate relationship between degree of iconicity, strategy of iconicity, and word or semantic category, elucidating whether all three factors collectively determine the degree of iconicity or if one factor exerts a more substantial influence. Additionally, exploring the potential impact of language experience and cultural background on iconicity ratings presents a compelling avenue for further research. This could involve the participation of native signers and the comparison of different sign languages to gain a more comprehensive understanding of these dynamics.

As this work has exclusively focused on the investigation of iconicity and its influences, there is a growing interest in delving deeper into research in this direction. At the same time, it is interesting to explore new aspects such as frequency and neighborhood density. Furthermore, the creation of a comprehensive database for ÖGS containing information on a wide range of linguistic aspects could make a significant contribution to research and a better understanding of ÖGS as a distinct and complex language.

10 Conclusion

This master's thesis aimed to contribute to further research examining language processes, especially in sign languages by not only to creating the first iconicity rating of ÖGS but to go one step further and investigate the interaction between the degree of iconicity and other factors such as lexical class, semantic category and strategy of iconicity.

To sum up, this master's thesis collected the first large scale iconicity rating in ÖGS and provided the first indication (to my knowledge) that the degree of iconicity is influenced by lexical class and possibly by semantic category and strategy of iconicity in a sign language. The study of iconicity is undoubtedly an important step in deepening our understanding of ÖGS and other sign languages. However, it is also desirable to create a database for ÖGS and explore other linguistic features that play a crucial role in the study of languages such as frequency or neighborhood density. Investigating these factors in ÖGS could enrich our understanding of this unique language and contribute valuable insights to the broader study of (sign) languages.

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Appendix A: Incorrect Stimuli and Homonyms

Table 1 | *List of Incorrect Stimuli*

Translation	Video
REISEN	reiten
BLUME	Blume
JAHR	Jacke
BROT	Boot
BART	Baby
KATZE	Keks
WARTEN	weinen
MAUS	Haus
BRAUCHEN	tauchen

Note. The column translation shows which translation is given for the video, and the column video shows which sign was used and combined with the translation.

Table 2 | *List of Homonyms*

Noun	Verb
Abmeldung	abmelden
Anfang	anfangen
Arbeit	arbeiten
Dolmetscher	dolmetschen
Entlassung	entlassen
Entscheidung	entscheiden
Erinnerung	erinnern
Feier	feiern
Führung	führen
Gebärde	gebärden
koch	kochen
Kommunikation	kommunizieren
Kuss	küssen
Organisation	organisieren
Pflege	pflegen
Reise	reisen
Spiel	spielen
Traum	träumen
Unterricht	unterrichten
Untersuchung	untersuchen
Verbrauch	verbrauchen
Vernachlässigung	vernachlässigen
Wissen	wissen

Appendix B: Instruction

Participants in the survey were provided with the following text as instructions:

Ein Teil der Gebärden in ÖGS ist bildhaft, das heißt, die Gebärde sieht irgendwie so aus wie das was sie bedeutet.

Die Gebärde KROKODIL (Video ist nachfolgend zu sehen) ist ein Beispiel für eine sehr bildhafte Gebärde, denn bei dieser Gebärde formen die Hände das Maul eines Krokodils und bewegen sich wie beim Öffnen und Schließen des

Mauls auf und ab. Auch wenn jemand ÖGS nicht gelernt hat, so könnte die Bedeutung dieser Gebärde also eventuell erraten werden.

Allerdings gibt es auch Gebärden, die überhaupt nicht ikonisch oder bildhaft sind. Ein Beispiel hierfür ist die Gebärde für SCHWESTER (Video ist unterhalb zu sehen). In diesem Fall sieht die Gebärde nicht aus wie eine Schwester und es wäre für Personen ohne Vorkenntnisse in ÖGS sehr schwer, zu erraten, was diese Gebärde bedeuten könnte.

Ein Beispiel für eine Gebärde, die zwischen diesen beiden Extremen liegt, ist die Gebärde SCHAF (Video ist unten zu sehen). Diese Gebärde stellt die Wolle des Schafs dar. Ohne aber die Bedeutung der Gebärde zu kennen, ist es eher unwahrscheinlich, diese Bedeutung zu erraten.

Im Fokus der Bewertung sollte der manuelle Teil der Gebärde stehen. Das ist der Teil, der die Hände der Person betrifft (die Form und Bewegung der Hände). Ikonizität, also ein Zusammenhang zwischen der Form einer Gebärde und ihrer Bedeutung, kann unterschiedlich aussehen. Z.B. kann eine Gebärde aus unterschiedlichen Gründen ikonisch sein. Manche dieser ikonischen Gebärden repräsentieren die Art und Weise wie ein bestimmter Gegenstand verwendet wird. Andere ikonische Gebärden repräsentieren die Form des Objekts.

Beantworte den Fragebogen bitte genau aber auch ohne zu lange über die Antworten nachzudenken. Du wirst jetzt eine Reihe von Gebärden und deren Bedeutung direkt über dem Video sehen und gebeten, auf einer Skala von 1 bis 7 zu bewerten, wie ähnlich die Gebärde ihrer Bedeutung sieht. Dabei steht 1 für „nicht ähnlich“ und 7 für „sehr ähnlich“. Hier ist Deine subjektive Meinung gefragt! Für manche Leute würde zum Beispiel KROKODIL eine Bewertung von 6 oder 7 auf dieser Skala bekommen, da die Gebärde sehr bildhaft ist. SCHWESTER hingegen würde eher eine Punktanzahl von 1 oder 2 erhalten und SCHAF könnte eine Bewertung zwischen 3 und 5 Punkten bekommen. Fühl Dich frei, die gesamte Skala auszunützen und mach Dir keine Gedanken, wie oft Du denselben Wert wählst, solange Deine Bewertung ehrlich ist.

Sollten während der Umfrage technische Probleme auftreten und das Video nicht zu sehen sein, dann wähle bitte die Option "technisches Problem" unterhalb der Skala. Um das Video anzusehen, klicke auf den Play-Button im Video.

Wenn Du bereit bist und alles verstanden hast, dann klicke bitte auf "Weiter"

Appendix C: Description of and Information about each ÖGS Noun and Verb

Table 1 provides details about every ÖGS noun and verb tested in this master's thesis. It includes information such as the ID in the LedaSila database, lexical class, whether it conveys an abstract or concrete meaning, and the assigned semantic category and strategy of iconicity. It is crucial to reiterate that the categorization into semantic categories and iconicity strategies involves subjective decisions, and individual perspectives may lead to variations in these assignments.

Table 1 | *Description of and Information about each ÖGS Noun and Verb*

ID in Leda-Sila	ÖGS Sign	Translation	Description	Lexical Class	Concrete / abstract	Semantic category	Strategy of Iconicity
#21517	ABHOLEN	pick up	signer imitates the act of grabbing something and pulling it towards oneself	Verb	concrete	action with obj	acting
#27726	ABMELDEN	sign off	right hand moves and taps the back of left hand	Verb	abstract	action without obj	no strategy
#27726	ABMELDUNG	deregistration	right hand moves and taps the back of left hand	Noun	abstract	unmanipulable obj.	no strategy
#21635	ADRESSE	address	hand with index finger extended is placed on left hand with index finger extended	Noun	concrete	unmanipulable obj.	no strategy
#5379	AFFE	monkey	signer highlights the scratching under the shoulders that is often associated with monkeys	Noun	concrete	animate entity	personification
#29486	ANFANG	beginning	right fist pushes down on the palm of the left hand	Noun	abstract	unmanipulable obj.	no strategy
#29486	ANFANGEN	begin	right fist pushes down on the palm of the left hand	Verb	abstract	action without obj	no strategy
#33303	ANKOMMEN	arrive	index finger moves toward the palm of the other hand and its arrival represents the arrival in general	Verb	abstract	action without obj	representing
#21773	ANMELDEN	register	right hand taps the back of the left hand	Verb	abstract	action without obj	no strategy
#34709	(DIR) ANTWORTEN	answer	index finger and middle finger of both hands tap each other	Verb	abstract	action without obj	no strategy
#34593	ANZEIGEN	indicate	hand moves away from chest	Verb	abstract	action without obj	no strategy
#24569	APPLAUS	applause	signer imitates the act of applauding	Noun	concrete	unmanipulable obj	acting
#4820	ARBEIT	work	both fists knock on each other	Noun	abstract	unmanipulable obj	no strategy
#4820	ARBEITEN	work	both fists knock on each other	Verb	abstract	action without obj	no strategy
#36979	ARMBANDUHR	watch	Index finger represents the hands of the watch on the wrist	Noun	concrete	manipulable obj	representing
#11631	ARZT	doctor	hand taps the back of the left hand	Noun	concrete	animate entity	no strategy
#36983	ATMEN	breathe	signer's hands are on the chest and symbolise the lifting of the chest when breathing	Verb	concrete	action without obj	representing
#33353	AUFBEWAHREN	store	right hand pushes something into a compartment, as if storing something	Verb	abstract	action with obj	representing
#34672	AUFMACHEN	open	signer imitates the action of opening a box or something	Verb	concrete	action with obj	acting
#33366	AUFSTEHEN	get up	signer's fingers represent the two feet that stand on the ground	Verb	concrete	action without obj	representing
#33527	AUFWACHEN	wake up	fingers stand for the eyes that are opened	Verb	concrete	action without obj	representing
#47751	AUSBORGEN	borrow	right hand taps into left hand	Verb	abstract	action with obj	no strategy
#45256	AUSRUTSCHEN	slip	hand slides over the other hand with a jerky movement, as if slipping	Verb	concrete	action without obj	representing
#22197	AUSSTEIGEN	get off	active hand moves away from passive hand, representing the act of getting out	Verb	concrete	action without obj	representing

#44260	AUSWÄH-LEN	choose	signer imitates the act of picking something	Verb	concrete	action with obj	acting
#4969	AUTO	car	signer imitates the action of driving a car	Noun	concrete	mani-pulable obj	acting
#51401	AUTOFAH-REN	drive a car	both hands form a fist that seem to hold a steer-ing wheel and move forward away from the body	Verb	concrete	action with obj	acting
#13279	BABY	baby	signer imitates rocking a baby	Noun	concrete	animate entity	acting
#29774	BANK (GELD-INSTITUT)	bank	both fists move downwards	Noun	concrete	unmani-pulable obj	no stra-tegy
#11669	BART	beard	signer shows where a typical beard grows	Noun	concrete	mani-pulable obj	represen-ting
#33681	BAUM	tree	upright arm represents the tree trunk, the other hand the treetop	Noun	concrete	unmani-pulable obj	represen-ting
#15773	BEISPIEL	example	right hand strokes the back of the left hand	Noun	abstract	unmani-pulable obj	no stra-tegy
#44268	BEKOMMEN	get	hand movement towards the body signals that the person is receiving something	Verb	abstract	action with obj	represen-ting
#29816	BELEIDIGEN	insult	middle finger quickly taps the back of the left hand	Verb	abstract	action without obj	no stra-tegy
#37068	BESPRE-CHEN	discuss	index fingers move alternately to the mouth and signal the exchange of conversation content dur-ing a meeting	Verb	concrete	action without obj	represen-ting
#46098	BESTELLEN	order	pointing finder tilts forward and points at some-thing	Verb	abstract	action with obj	no stra-tegy
#11700	BETT	bed	signer's hand shows the outer edges of the bed	Noun	concrete	unmani-pulable obj	drawing
#33706	BEZAHLEN	pay	thumb strokes the palm of the hand	Verb	concrete	action with obj	no stra-tegy
#6180	BLEIBEN	stay	signer presses the palms down	Verb	abstract	action without obj	acting
#6202	BLUME	flower	hand represents the blossoming of the bud of a flower	Noun	concrete	unmani-pulable obj	represen-ting
#29872	BOOT	boat	signer's hand forms the shape of a ship's bow	Noun	concrete	unmani-pulable obj	represen-ting
#6244	BRAUCHEN	need	right hand taps left hand several times	Verb	abstract	action without obj	no stra-tegy
#10325	BRIEF	letter	signer draws the outline of an envelope	Noun	concrete	mani-pulable obj	drawing
#6289	BRILLE	glasses	signers hand forms the round contour of glasses	Noun	concrete	mani-pulable obj	represen-ting
#34842	BRINGEN	bring	hands symbolically represent that something is being brought from A to B	Verb	concrete	action with obj	represen-ting
#6305	BROT	bread	signer's hand represents a loaf of bread that is being cut	Noun	concrete	mani-pulable obj	represen-ting
#6314	BRUDER	brother	both index fingers touch each other	Noun	concrete	animate entity	no stra-tegy
#11754	BUCH	book	signer imitates opening a book	Noun	concrete	mani-pulable obj	acting
#10020	CHEF	boss	the hand with the thumb up points upwards	Noun	concrete	animate entity	no stra-tegy
#45347	DENKEN	think	signer's index finger taps on temple	Verb	abstract	psycholo-gical	metapho-rical
#29699	DOLMET-SCHEN	inter-prete	movement of the hands shows scrolling through the dictionary	Verb	concrete	action without obj	represen-ting

#29699	DOL-MET-SCHER	inter-preter	movement of the hands shows scrolling through the dictionary	Noun	concrete	animate entity	represen-ting
#10120	DÜRFEN	may	index fingers touch in front of the body and then move apart outwards	Verb	abstract	action without obj	no stra-tegy
#34216	DURST	thirst	signer's hand goes away from the throat to sig-nal thirst	Noun	abstract	unmani-pulable obj	represen-ting
#30786	DVD	DVD	both hands with the index fingers extended tap each other	Noun	concrete	mani-pulable obj	no stra-tegy
#30730	EI	egg	index finger and thumb form a circle that moves to the chin	Noun	concrete	mani-pulable obj	no stra-tegy
#20942	EINSCHLA-FEN	fall as-leep	signer 's finger represent the act of closing the eyes when falling asleep	Verb	concrete	action without obj	represen-ting
#35505	EINSTEIGEN	get on	active hand moves to passive, symbolizing get-ting in	Verb	concrete	action without obj	represen-ting
#34232	EISCREME	ice cream	signer imitates the action of licking ice cream	Noun	concrete	mani-pulable obj	acting
#51232	ELTERN	parents	hand strokes the cheek and then taps the cheek with the fist	Noun	abstract	animate entity	no stra-tegy
#35570	EMPFEHLEN	recom-mend	both flat hands move forward from the mouth	Verb	abstract	action without obj	no stra-tegy
#50737	ENDE	end	the end is symbolically represented by the left hand being “cut off”	Noun	abstract	unmani-pulable obj	represen-ting
#14942	ENTDECKEN	discover	right hand is placed on left hand	Verb	abstract	action without obj	no stra-tegy
#18629	ENTE	duck	signer highlights the beak of a duck	Noun	concrete	animate entity	personifi-cation
#35622	ENTLASSEN	dismiss	index finger moves under the index finger of the passive hand	Verb	abstract	action without obj	no stra-tegy
#35622	ENTLAS-SUNG	dismissal	index finger moves under the index finger of the passive hand	Noun	abstract	unmani-pulable obj	no stra-tegy
#34922	ENTSCHEI-DEN	decide	both index fingers move forward and apart from the body	Verb	abstract	action without obj	no stra-tegy
#34922	ENT-SCHEIDUNG	decision	both index fingers move forward and apart from the body	Noun	abstract	unmani-pulable obj	no stra-tegy
#35669	ERFINDEN	invent	signer's hand moves away from the head	Verb	abstract	psycholo-gical	metapho-rical
#24317	ERINNERN	remem-ber	index finger strokes head	Verb	abstract	psycholo-gical	metapho-rical
#24317	ERINNE-RUNG	memory	index finger strokes head	Noun	abstract	psycholo-gical	metapho-rical
#12351	ERMAHNEN	exhort	signer moves index finger and imitates the ac-tion of admonishing someone	Verb	abstract	action without obj	acting
#12931	ESSEN	eat	signer imitates the action of eating	Verb	concrete	action with obj	acting
#30445	FAHREN	drive	wrist circles in front of the body	Verb	concrete	action with obj	no stra-tegy
#30191	FAHRRAD	bike	signer's hands imitate the action of bicycling and pedal	Noun	concrete	mani-pulable obj	acting
#11368	FANGEN	catch	signer imitates the action of catching something	Verb	concrete	action with obj	acting
#4214	FEIER	party	the hands are shaken in front of the upper body	Noun	abstract	unmani-pulable obj	no stra-tegy
#4214	FEIERN	celebrate	the hands are shaken in front of the upper body	Verb	abstract	action without obj	no stra-tegy

#34273	FERNSEHEN	watch TV	hand is spread open in front of the face several times	Verb	concrete	action with obj	no strategy
#34280	FILM	film	hand moves in a circular shape and represents the film reels being played	Noun	abstract	unmanipulable obj	representing
#39677	FINDEN	find	signer imitates the act of picking something out of a crowd	Verb	concrete	action with obj	acting
#29297	FISCH	fish	flat hand symbolizes fish body and the thumb the fin	Noun	concrete	animate entity	representing
#30221	FLASCHE	bottle	signer draws the contour of a bottle	Noun	concrete	unmanipulable obj	drawing
#30244	FLUGZEUG	airplane	hand recreates the shape of airplane	Noun	concrete	unmanipulable obj	representing
#37461	FOLGEN	follow	one hand follows the other	Verb	concrete	action without obj	representing
#15043	FÖRDERN	fund	hands move as if they want to push something up	Verb	abstract	action without obj	no strategy
#15051	FORSCHEN	research	bent index finger and middle finger of both hands move towards and away from each other in front of the body	Verb	abstract	action without obj	no strategy
#36513	FRAGEN	ask	hand moves forward from mouth	Verb	abstract	action without obj	no strategy
#3439	FRAU	woman	hand moves from the corners of the mouth to the jaw line	Noun	concrete	animate entity	no strategy
#12625	FREUEN	be happy	both hands stroke over the upper body, at the same time a joyful facial expression	Verb	abstract	action without obj	representing
#12628	FREUND	friend	hand knocks on the heart	Noun	concrete	animate entity	no strategy
#40237	FÜHREN	guide	passive hand guides the active hand and represents a person that is being guided?	Verb	abstract	action without obj	representing
#40237	FÜHRUNG	guidance	passive hand guides the active hand and represents a person that is being guided	Noun	abstract	unmanipulable obj	representing
#47507	FUNKTION	function	both index fingers and thumb form a circle and touch each other	Noun	abstract	unmanipulable obj	no strategy
#34398	GEBÄRDE	repair	signer imitates the act of signing	Noun	concrete	manipulable obj	acting
#34398	GEBÄRDEN	sign	signer imitates the act of signing	Verb	concrete	action without obj	acting
#44314	GEBEN	give	the act of giving is imitated by a movement away from the body towards the recipient	Verb	concrete	action with obj	acting
#14338	GEFÜHL	feeling	hand strokes arm	Noun	abstract	unmanipulable obj	representing
#10777	GEHEN	walk	signer's fingers represent the two feet that walk	Verb	concrete	action without obj	representing
#3523	GESCHÄFT	shop	the fingers press against each other and rotate and tap each other alternately	Noun	concrete	unmanipulable obj	no strategy
#24321	GLAUBEN	believe	flat hand with thumb pressed against fingers taps signer's temple	Verb	abstract	psychological	metaphorical
#35176	GOTT	god	Signer point with index finger upwards	Noun	abstract	/	/
#34471	GRAS	grass	little fingers represent growing grass	Noun	concrete	unmanipulable obj	representing
#50804	GRÜSSEN	greet	hands move slightly in front of the body	Verb	concrete	action without obj	no strategy
#35454	GÜRTEL	belt	signer imitates the fastening of a belt	Noun	concrete	manipulable obj	acting

#50806	HALTEN	kiss	signer imitates the action of holding something	Verb	concrete	action with obj	acting
#13112	HAND	hand	signer directly shows her hand to refer to it	Noun	concrete	bodypart	direct referencing
#3599	HAND-SCHUH	glove	signer strokes hand as if the glove is put on	Noun	concrete	manipulable obj	representing
#13375	HASE	rabbit	signer's fingers represent rabbit ears	Noun	concrete	animate entity	personification
#3605	HAUS	house	signer's hand draws the contour of a typical house	Noun	concrete	unmanipulable obj	drawing
#43985	HELFEN	help	right edge of the hand lies on the left edge of the hand and moves upwards	Verb	abstract	action without obj	no strategy
#43985	HEXE	witch	signer highlights the nose of a witch	Noun	concrete	animate entity	personification
#31162	HINEINGEHEN	enter	right hand moves under the flat left hand and represents the act of entering	Verb	concrete	action without obj	representing
#14065	HOLZ	wood	hands represent the act of chopping wood	Noun	abstract	unmanipulable obj	representing
#29283	HÖRGERÄT	hearing aid	signer imitates the action of putting the hearing aid on the ears	Noun	concrete	manipulable obj	acting
#30872	HOSE	pants	signer imitates the act of pulling up one's pants and putting them on	Noun	concrete	manipulable obj	acting
#14089	HOTEL	hotel	forearm is positioned upright with the index and middle fingers extended	Noun	concrete	unmanipulable obj	no strategy
#34537	HUBSCHRAUBER	helicopter	the shaking flat hand represent the rotor blades of a helicopter	Noun	concrete	unmanipulable obj	representing
#30549	HUND	dog	signer highlights the snout of a dog or barking of a dog	Noun	concrete	animate entity	personification
#28263	HUNGER	hunger	hand circles over stomach to signal hunger	Noun	abstract	unmanipulable obj	representing
#36528	HUSTEN	cough	hands move on the chest, represents the urge to cough	Verb	concrete	action without obj	representing
#27257	IDEE	idea	signer's index finger moves away from temple (as if releasing an idea)	Noun	abstract	psychological	metaphorical
#41483	IGNORIEREN	ignore	signer taps his nose and then moves hand forward with his hand	Verb	abstract	action without obj	no strategy
#26625	INSEL	island	signer highlights the circular shape of an island	Noun	concrete	unmanipulable obj	drawing
#30396	JACKE	jacket	signer imitates the action of putting on a jacket	Noun	concrete	manipulable obj	acting
#3876	JAHR	year	hands rotate in front of the body like a wheel	Noun	abstract	unmanipulable obj	no strategy
#6319	JUNGE	boy	index and middle finger tap temple	Noun	concrete	animate entity	no strategy
#30721	KAFFEE	coffee	both fists with the index and middle fingers extended circle towards each other	Noun	concrete	unmanipulable obj	no strategy
#34002	KALENDER	calendar	flat hand represents the calendar page that is turned over when the new week begins	Noun	concrete	manipulable obj	representing
#44900	KAMERA	camera	signer imitates the action of taking a photo with a camera	Noun	concrete	manipulable obj	acting
#25825	KAMM	comb	signer imitates the action of combing one's hair	Noun	concrete	manipulable obj	acting

#29448	KARTOFFEL	potato	signer imitates the act of peeling potatoes	Noun	concrete	manipulable obj	acting
#34016	KÄSE	cheese	right index and middle finger tap the left index and middle finger	Noun	concrete	manipulable obj	no strategy
#3922	KATZE	cat	signer highlights the whisker of a cat	Noun	concrete	animate entity	personification
#31370	KAUFEN	buy	active hand taps the left hand with the bent index finger	Verb	concrete	action with obj	no strategy
#48727	KEKS	cookie	signer represents the round shape of a cookie	Noun	concrete	manipulable obj	representing
#16784	KIND	child	signer highlights that something/someone is small	Noun	concrete	animate entity	personification
#29458	KIRSCHE	cherry	index and middle fingers move on the ear	Noun	concrete	manipulable obj	no strategy
#30434	KLEID	dress	hands move down the body and show the shape of the dress	Noun	concrete	manipulable obj	representing
#31546	KLEIDUNG	clothes	hands stroke over the chest several times	Noun	concrete	unmanipulable obj	no strategy
#43250	KLETTERN	climb	signer imitates the action of climbing up a ladder	Verb	concrete	action without obj	acting
#30457	KOCH	chef	signer imitates the action of cooking	Noun	concrete	animate entity	acting
#30457	KOCHEN	cook	signer imitates the action cooking	Verb	concrete	action with obj	acting
#44913	KOMMUNIKATION	communication	hands move alternately to the mouth and represent the exchange in the conversation	Noun	abstract	unmanipulable obj	representing
#44913	KOMMUNIZIEREN	communicate	hands move alternately to the mouth and represent the exchange in the conversation	Verb	concrete	action without obj	representing
#20210	KÖNIG	king	signer highlights the crown of a king	Noun	concrete	animate entity	personification
#30471	KÖNNEN	can	extended index finger and middle finger move up and down	Verb	abstract	action without obj	no strategy
#3966	KOPF	head	signer brings his hand to the side of his head to refer to the head	Noun	concrete	bodypart	pointing
#43317	KOPIEREN	copy	active hand pulls something from the left hand downwards	Verb	concrete	action with obj	no strategy
#34061	KÖRPER	body	signer moves down the body to refer to it	Noun	concrete	bodypart	direct referencing
#50880	KÜNDIGEN	resign	middle fingers move forward from the eyes	Verb	concrete	action without obj	no strategy
#23074	KUSS	kiss	signer's hand represents the lips that are kissing	Noun	concrete	unmanipulable obj	representing
#23074	KÜSSEN	kiss	signer's hand represents the lips that are kissing	Verb	concrete	action with obj	representing
#45810	LACHEN	laugh	fingers point to the cheeks or corners of the mouth that lift when you laugh	Verb	concrete	action without obj	representing
#17174	LAND	country	both index fingers draw a circle	Noun	concrete	unmanipulable obj	no strategy
#16442	LAPTOP	cigar	flat hand represents screen being folded up	Noun	concrete	manipulable obj	representing
#51181	LAUFEN	run	signer moves arms as is typically done while running	Verb	concrete	action without obj	acting
#29920	LEBEN	live	the hands with an extended index finger and thumb move outwards from below in a circular motion	Verb	abstract	action without obj	no strategy

#21673	LERNEN	learn	flat hand with thumb pressed against fingers moves for and back at the temple	Verb	abstract	psychological	metaphorical
#30429	LESEN	read	flat hand represents text that is being read	Verb	concrete	action with obj	representing
#21802	LIEGEN	lie	hands fall over and symbolize lying down	Verb	concrete	action without obj	representing
#22030	LÜGEN	lie	index finger strokes cheek	Verb	abstract	action without obj	no strategy
#28809	MACHEN	do	both fists knock on each other	Verb	abstract	action without obj	no strategy
#20036	MALEN	paint	signer imitates the act of painting something with the fingers	Verb	concrete	action with obj	acting
#4093	MANN	man	back of the right hand circles the cheek	Noun	concrete	animate entity	no strategy
#20211	MAUS	send	signer highlights the ability of mice to disappear in small holes	Noun	concrete	animate entity	representing
#24985	MENSCH	human	hand moves to forehead and index and middle fingers press on the thumb	Noun	concrete	animate entity	no strategy
#24381	MERKEN	memorise	flat hand, with thumb pressed against fingers, presses on temple	Verb	abstract	psychological	metaphorical
#19438	MIT DEM FLUGZEUG FLIEGEN	fly by plane	hands represent airplane taking off	Verb	concrete	action with obj	representing
#34126	MÖGEN	like	signer represents the act of liking something by stroking the chest	Verb	abstract	action without obj	representing
#4148	MONAT	month	index finger moves from top to bottom	Noun	abstract	unmanipulable obj	no strategy
#24825	MOND	moon	hands draw the crescent shape of the moon	Noun	concrete	unmanipulable obj	drawing
#24050	MUSIK	music	signer imitates the act of conducting an orchestra or something	Noun	abstract	unmanipulable obj	acting
#29922	MÜSSEN	must	both hands move downwards abruptly	Verb	abstract	action without obj	no strategy
#20458	MUTTER	mother	index and middle finger tap both cheeks	Noun	concrete	animate entity	no strategy
#31369	NÄHEN	sew	signer imitates the action of sewing with needle and thread	Verb	concrete	action with obj	acting
#20546	NEHMEN	take	signer imitates the action of grabbing/taking something	Verb	concrete	action with obj	acting
#20616	NUSS	nut	index finger and thumb form a circle that moves at the level of the mouth	Noun	concrete	manipulable obj	no strategy
#18534	OMA	grandmother	hand touches both cheeks	Noun	concrete	animate entity	no strategy
#18591	ONKEL	uncle	hand moves forward in a circular motion from the forehead	Noun	concrete	animate entity	no strategy
#18574	OPA	grandfather	hand taps from the chin to the forehead	Noun	concrete	animate entity	no strategy
#15215	ORGANISATION	organisation	both index fingers and thumbs form circles that interlock and move in a circular motion	Noun	abstract	unmanipulable obj	no strategy
#15215	ORGANISIEREN	organise	both index fingers and thumb form circles that interlock and move in a circular motion	Verb	abstract	action without obj	no strategy
#31857	PAUSE	break	shaking the hand represents the ringing of the school bell	Noun	abstract	unmanipulable obj	representing
#30603	PERSON	person	index finger and thumb form a C that slides from top to bottom in front of the body	Noun	abstract	animate entity	no strategy
#29776	PFEIFE	pipe	hand recreates the shape of the pipe and how it is held	Noun	concrete	manipulable obj	representing

#21385	PFERD	horse	hands recreate the bridle of a horse	Noun	concrete	animate entity	representing
#35387	PFLEGE	care	both hands with the index and middle fingers extended move forward in a circle	Noun	abstract	unmanipulable obj	no strategy
#35387	PFLEGEN	care	both hands with the index and middle fingers extended move forward in a circle	Verb	abstract	action without obj	no strategy
#31252	PRIESTER	priest	signer highlights the typical collar of priests	Noun	concrete	animate entity	personification
#50968	PROBIEREN	try	signer imitates the act of trying something, smelling it with the nose	Verb	concrete	action with obj	acting
#19456	PROBLEM	problem	both hands rotate and tap each other	Noun	abstract	unmanipulable obj	no strategy
#19481	PUTZEN	clean	signer imitates the action of cleaning or wiping something with a cloth	Verb	concrete	action with obj	acting
#30238	RADFAHREN	ride a bike	signer's hands imitate the action of bicycling and pedal	Verb	concrete	action with obj	acting
#26388	RASIEREN	shave	signer imitates the act of shaving one's face	Verb	concrete	action with obj	acting
#24131	REGEN	rain	shaking hands represent rain	Noun	concrete	unmanipulable obj	representing
#24382	REISE	journey	hand moves forward from head	Noun	abstract	unmanipulable obj	no strategy
#24382	REISEN	travel	hand moves forward from head	Verb	abstract	action without obj	no strategy
#34366	REITEN	ride a horse	fingers represent rider on horse	Verb	concrete	action with obj	representing
#34368	REPARIEREN	repair	active hand moves and touches the left hand	Verb	concrete	action with obj	no strategy
#40424	SAGEN	say	index finger moves away from the mouth, representing the utterance	Verb	concrete	action without obj	representing
#50996	SAMMELN	collect	signer imitates the act “shovelling something to oneself” to collect something	Verb	concrete	action with obj	representing
#40516	SCHAFFEN	accomplish	fist moves to chest	Verb	abstract	action without obj	no strategy
#51009	SCHICKEN	send	hand goes away from the body, representing something being released or sent away	Verb	concrete	action with obj	representing
#18182	SCHIRM	umbrella	signer imitates the act of opening an umbrella	Noun	concrete	manipulable obj	acting
#30448	SCHLAFEN	sleep	signer presses folded hands on the cheeks to signal sleeping	Verb	concrete	action without obj	acting
#30175	SCHLEICHEN	sneek	signer's hand symbolises the slow and careful act of sneeking	Verb	concrete	action without obj	representing
#24132	SCHNEE	snow	hands move downwards with wiggling fingers, representing snow	Noun	concrete	unmanipulable obj	representing
#41640	SCHOKOLADE	chocolate	signer's hand shows the form of a chocolate bar	Noun	concrete	manipulable obj	drawing
#33888	SCHREIBEN	write	signer imitates the act of writing in one's hand, the flat hand represents a piece of paper, the other hand represents a pen	Verb	concrete	action with obj	representing
#36327	SCHULD	guilt	thumb and index finger form a C that moves from left to right	Noun	abstract	unmanipulable obj	no strategy
#33885	SCHULE	school	hand moves forward and back on the temple	Noun	abstract	unmanipulable obj	no strategy
#33877	SCHWEIN	pig	signer highlights the pig's nose	Noun	concrete	animate entity	personification

#33873	SCHWIM-MEN	swim	signer imitates the action swimming	Verb	concrete	action without obj	acting
#4300	SEGELN	sail	upright arm symbolizes the sailing mast of a boat	Verb	concrete	action with obj	represen-ting
#16027	SEHEN	see	signer points away from the eyes	Verb	concrete	action with obj	represen-ting
#39775	SOCKEN	socks	both hands move the wrists	Noun	concrete	mani-pulable obj	no stra-tegy
#4334	SOHN	son	hand moves to the chest	Noun	concrete	animate entity	no stra-tegy
#51041	SOLLEN	should	index finger is moved to command something	Verb	abstract	action without obj	no stra-tegy
#33848	SPASS	fun	bent index finger taps the chin	Noun	abstract	unmani-pulable obj	no stra-tegy
#16094	SPIEL	game	signer imitates the act of playing or juggling	Noun	abstract	unmani-pulable obj	acting
#16094	SPIELEN	play	signer imitates the act of playing or juggling	Verb	abstract	action with obj	acting
#24486	SPORT	sports	both hands with thumbs up alternately move the thumb towards the body	Noun	abstract	unmani-pulable obj	no stra-tegy
#18851	SPRECHEN	speak	Index finger strokes lips, representing what is being said	Verb	concrete	action without obj	represen-ting
#18890	STADT	city	the active hand places all fingers like a dome on the flat passive hand	Noun	abstract	unmani-pulable obj	no stra-tegy
#37492	STEHEN	stand	signer's fingers represent the two feet that stand on the ground	Verb	concrete	action without obj	represen-ting
#42615	STEHLEN	steal	signer imitates the act of stealing and putting something in one's pockets cleverly and unno-ticed	Verb	concrete	action with obj	acting
#28335	STERBEN	die	hand jerks forward and represents "dropping dead"	Verb	concrete	action without obj	represen-ting
#4388	STUNDE	hour	both index fingers tap each other	Noun	abstract	unmani-pulable obj	no stra-tegy
#18994	SUCHEN	search	both hands move in circles in front of the body	Verb	concrete	action without obj	no stra-tegy
#29862	TAG	day	hand moves upwards and outwards from the stomach	Noun	abstract	unmani-pulable obj	no stra-tegy
#24348	TANZEN	dance	hands circling around each other representing the spinning of dancers	Verb	concrete	action without obj	represen-ting
#24521	TAUCHEN	dive	signer represents the act of diving by moving the active hand downwards. The passive hand re-presents the surface	Verb	concrete	action without obj	represen-ting
#38713	TEIL	part	signer's divides the flat hand in two halves	Noun	concrete	unmani-pulable obj	represen-ting
#32345	TIER	animal	signer highlights the feelers of an insect	Noun	concrete	animate entity	personifi-cation
#45610	TÖTEN	kill	signer imitates the action of stabbing /killing someone	Verb	concrete	action with obj	acting
#28775	TRAUM	dream	hand circles around the head	Noun	abstract	psycholo-gical	metapho-rical
#28775	TRÄUMEN	dream	hand circles in front of head	Verb	abstract	psycholo-gical	metapho-rical
#19322	TREFFEN	meet	hands move together, meet each other	Verb	concrete	action with obj	represen-ting
#28795	TRINKEN	drink	signer imitates the act of drinking	Verb	concrete	action with obj	acting

#38744	TROCKNEN	dry	both hands pull apart	Verb	concrete	action without obj	no strategy
#30602	TÜR	door	hand moves back and away from other hand, representing the opening and closing of the door	Noun	concrete	manipulable obj	representing
#4566	TURNEN	exercise	signer imitates the act of exercising by acting as if lifting some weights	Verb	concrete	action without obj	acting
#4568	ÜBEN	practice	hand moves in circular shape representing the effort when practicing	Verb	concrete	action without obj	representing
#35545	ÜBERHOLEN	overtake	one hand overtakes the other	Verb	concrete	action without obj	representing
#17899	ÜBERLEGEN	reason	signer's fingers "drill" into temple as if digging in one's thoughts	Verb	abstract	psychological	metaphorical
#35717	ÜBERSETZEN	translate	hands transport something from A to B	Verb	concrete	action without obj	representing
#33627	UMFALLEN	fall over	fingers represent the act of falling over	Verb	concrete	action without obj	representing
#33622	UNTERRICHT	class	both hands move outwards in front of the body in small circular movements	Noun	abstract	unmanipulable obj	no strategy
#33622	UNTERRICHTEN	teach	both hands move outwards in front of the body in small circular movements	Verb	abstract	action without obj	no strategy
#32349	UNTERSCHREIBEN	sign	signer taps his right hand into the flat of his left hand and then into the empty space in front of his left hand	Verb	concrete	action with obj	representing
#33621	UNTER-SUCHEN	examine	index finger and middle finger of both hands circle around each other	Verb	abstract	action without obj	no strategy
#33621	UNTER-SUCHUNG	examination	index finger and middle finger of both hands circle around each other	Noun	abstract	unmanipulable obj	no strategy
#24262	UNTERTITEL	subtitle	signer's fingers represent the subtitle	Noun	concrete	unmanipulable obj	representing
#18067	URLAUB	vacation	fingers of both hands wiggle in front of the chest	Noun	abstract	unmanipulable obj	no strategy
#30342	VATER	father	index and middle finger tap on the chin and forehead	Noun	concrete	animate entity	no strategy
#51088	VERBRAUCH	usage	fanning away represents that something is given away/used up	Noun	abstract	unmanipulable obj	representing
#51088	VERBRAUCHEN	consume	fanning away represents that something is given away/used up	Verb	abstract	action without obj	representing
#15564	VERFOLGEN	trace	one hand follows the other	Verb	concrete	action with obj	representing
#17574	VERGESSEN	forget	hand pulls something away from head (representing the loss of knowledge, the act of forgetting)	Verb	abstract	psychological	metaphorical
#15574	VERHAFTEN	arrest	hands form handcuffs or, putting on handcuffs	Verb	concrete	action with obj	representing
#23632	VERHANDELN	negotiate	palms move alternately towards the body, representing different positions or different contributions to arguments in a negotiation	Verb	concrete	action without obj	representing
#28781	VERKAUFEN	sell	both hands pull apart in front of the body	Verb	concrete	action with obj	no strategy
#39426	VERNACHLÄSSIGEN	neglect	signer imitates the action of pushing something aside	Verb	abstract	action without obj	acting
#39426	VERNACHLÄSSIGUNG	neglect	signer imitates the action of pushing something aside	Noun	abstract	unmanipulable obj	acting
#17707	VERSCHWINDEN	disappear	hands move apart suddenly and symbolize emptiness, the disappearance of something.	Verb	abstract	action without obj	representing

#33535	VERSTE-CKEN	hide	one hand pushes behind the other, representing the act of hiding	Verb	abstract	action with obj	represen-ting
#29949	VERSTEHEN	under-stand	hand moves back and forth in front of the face	Verb	abstract	psycholo-gical	metapho-rical
#32713	VOGEL	bird	signer highlights the beak of a bird	Noun	concrete	animate entity	personifi-cation
#24583	VORHANG	curtain	hands show shape of curtain	Noun	concrete	mani-pulable obj	represen-ting
#38673	VORSTEL-LEN (IN GE-DANKEN)	imagine	flat hand circles in front of the face	Verb	abstract	psycholo-gical	metapho-rical
#38678	WARNEN	warn	signer moves index finger and imitates the ac-tion of admonishing someone	Verb	abstract	action without obj	acting
#17056	WARTEN	wait	hand with outstretched thumb and index finger strokes chest	Verb	abstract	action without obj	no stra-tegy
#36674	WASSER	water	hand with bent fingers moves from left to right in front of the mouth	Noun	concrete	unmani-pulable obj	no stra-tegy
#30452	WEINEN	cry	signer's fingers show where tears flow down while crying	Verb	concrete	action without obj	represen-ting
#29054	WERFEN	throw	signer imitates the action of throwing something away	Verb	concrete	action with obj	acting
#33482	(DAS) WIS-SEN	know-ledge	flat hand taps head several times	Noun	abstract	psycholo-gical	metapho-rical
#33482	(ETWAS) WISSEN	know	flat hand taps several times on temple	Verb	abstract	psycholo-gical	metapho-rical
#19958	WOCHE	week	thumb and index finger form a C that moves from left to right	Noun	abstract	unmani-pulable obj	no stra-tegy
#37227	WOLKE	cloud	signer's hand moves in small circles to represent clouds	Noun	concrete	unmani-pulable obj	represen-ting
#33486	WOLLEN	want	bent pointer and middle finger tap the chin	Verb	abstract	action without obj	no stra-tegy
#33475	WÜNSCHEN	wish	signer acts as if drawing something towards oneself, to bring it into one's possession, want-ing to have something	Verb	abstract	action without obj	represen-ting
#30633	ZAHN-BÜRSTE	tooth brush	signer imitates the act of brushing one's teeth with a toothbrush	Noun	concrete	mani-pulable obj	acting
#14565	ZAUBER	magic spell	signer imitates the act of doing magic	Noun	abstract	unmani-pulable obj	acting
#32156	ZEIGEN	show	tapping the palm of your hand and moving it for-ward makes it clear that the person opposite is looking here, meaning that something is being shown	Verb	concrete	action with obj	represen-ting
#16877	ZEIT	dismiss	signer's hand represents the hand of a clock that rotates	Noun	abstract	unmani-pulable obj	represen-ting
#15764	ZENTRUM	centre	thumb taps into the “centre” of the palm	Noun	concrete	unmani-pulable obj	represen-ting
#42541	ZERBRE-CHEN	break	signer imitates the action of breaking something in two halves	Verb	concrete	action with obj	acting
#33454	ZIGARRE	laptop	signer shows the shape of a cigar	Noun	concrete	mani-pulable obj	represen-ting
#5073	ZUG	train	hands move in circular motions, representing the movement of the train wheels	Noun	concrete	unmani-pulable obj	represen-ting
Link	**ÖGS sign**	**Transla-tion**	**Description**	**Lexi-cal Class**	**Concrete/ abstract**	**Semantic category**	Strategy

[46]	E-Mail	E-Mail	both index fingers and thumb form a C and slide over each other in front of the body	Noun	concrete	unmani-pulable obj	no stra-tegy

Appendix D: Post Hoc Comparisons

Table 1| *Dunn's Post Hoc Comparisons - Semantic Category Analysis 1*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
action with obj - action without obj	2.917	183.090	139.301	0.004 **	0.074	0.053
action with obj - animate entity	3.994	183.090	108.647	< .001 ***	0.001 **	0.001 **
action with obj - bodypart	-0.834	183.090	224.667	0.404	1.000	1.000
action with obj - manipulable	0.306	183.090	177.472	0.759	1.000	1.000
action with obj - psychological	-0.751	183.090	201.188	0.452	1.000	1.000
action with obj - unmanipulable	4.657	183.090	110.331	< .001 ***	< .001 ***	< .001 ***
action without obj - animate entity	1.795	139.301	108.647	0.073	1.000	0.654
action without obj - bodypart	-1.732	139.301	224.667	0.083	1.000	0.666
action without obj - manipulable	-2.281	139.301	177.472	0.023 *	0.474	0.271
action without obj - psychological	-2.703	139.301	201.188	0.007 **	0.144	0.096
action without obj - unmanipulable	2.112	139.301	110.331	0.035 *	0.728	0.347
animate entity - bodypart	-2.297	108.647	224.667	0.022 *	0.454	0.271
animate entity - manipulable	-3.432	108.647	177.472	< .001 ***	0.013 *	0.010 **
animate entity - psychological	-3.640	108.647	201.188	< .001 ***	0.006 **	0.005 **
animate entity - unmanipulable	-0.096	108.647	110.331	0.924	1.000	1.000
bodypart - manipulable	0.937	224.667	177.472	0.349	1.000	1.000
bodypart - psychological	0.445	224.667	201.188	0.656	1.000	1.000
bodypart - unmanipulable	2.311	224.667	110.331	0.021 *	0.437	0.271
manipulable - psychological	-0.941	177.472	201.188	0.347	1.000	1.000
manipulable - unmanipulable	3.884	177.472	110.331	< .001 ***	0.002 **	0.002 **
psychological - unmanipulable	3.899	201.188	110.331	< .001 ***	0.002 **	0.002 **

* p < .05, ** p < .01, *** p < .001

[46]The ÖGS sign EMAIL is the only sign used in this master thesis that used a video that is not from the LedaSila database. Instead, this video can be found on the GESTU platform under the following link: https://fachgebaerden.tsc.tuwien.ac.at/httpsfachgebaerdentsctuwienacatgebaerdenactionlist/e-mail/

Table 2 | *Dunn's Post Hoc Comparisons - Semantic Category Analysis 2*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
action with obj - action without obj	2.895	175.090	134.470	0.004 **	0.038 *	0.023 *
action with obj - animate entity	4.040	175.090	104.706	< .001 ***	< .001 ***	< .001 ***
action with obj - manipulable	0.365	175.090	168.833	0.715	1.000	1.000
action with obj - unmanipulable	4.637	175.090	107.390	< .001 ***	< .001 ***	< .001 ***
action without obj - animate entity	1.865	134.470	104.706	0.062	0.622	0.187
action without obj - manipulable	-2.197	134.470	168.833	0.028 *	0.280	0.140
action without obj - unmanipulable	2.112	134.470	107.390	0.035 *	0.346	0.140
animate entity - manipulable	-3.421	104.706	168.833	< .001 ***	0.006 **	0.004 **
animate entity - unmanipulable	-0.163	104.706	107.390	0.870	1.000	1.000
manipulable - unmanipulable	3.804	168.833	107.390	< .001 ***	0.001 **	0.001 **

* p < .05, ** p < .01, *** p < .001

Table 3 | *Dunn's Post Hoc Comparisons – Strategy of Iconicity- Analysis 3*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
acting - drawing	1.622	77.610	46.667	0.105	0.629	0.419
acting - personification	3.771	77.610	33.333	< .001	< .001	< .001
acting - representing	5.213	77.610	43.561	< .001	< .001	< .001
drawing - personification	0.627	46.667	33.333	0.531	1.000	1.000
drawing - representing	0.164	46.667	43.561	0.869	1.000	1.000
personification - representing	-0.894	33.333	43.561	0.371	1.000	1.000

* p < .05, ** p < .01

Table 4 | Dunn's Post Hoc Comparisons – Strategy of Iconicity in Nouns - Analysis 3

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
acting - drawing	1.492	38.563	24.333	0.136	0.814	0.542
acting - personification	3.415	38.563	17.000	< .001 ***	0.004 **	0.004 **
acting - representing	3.327	38.563	22.292	< .001 ***	0.005 **	0.004 **
drawing - personification	0.726	24.333	17.000	0.468	1.000	1.000
drawing - representing	0.220	24.333	22.292	0.826	1.000	1.000
personification - representing	-0.893	17.000	22.292	0.372	1.000	1.000

* p < .05, ** p < .01

Table 5 | *Dunn's Post Hoc Comparisons – Strategy- Analysis 4*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
acting - drawing	2.688	123.194	64.429	0.007 **	0.108	0.101
acting - metaphorical	1.457	123.194	100.625	0.145	1.000	1.000
acting - personification	2.310	123.194	83.083	0.021 *	0.314	0.272
acting - representing	4.658	123.194	80.078	< .001 ***	< .001 ***	< .001 ***
acting - direct referencing	0.016	123.194	122.667	0.987	1.000	1.000
drawing - metaphorical	-1.468	64.429	100.625	0.142	1.000	1.000
drawing - personification	-0.721	64.429	83.083	0.471	1.000	1.000
drawing - representing	-0.735	64.429	80.078	0.463	1.000	1.000
drawing - direct referencing	-1.551	64.429	122.667	0.121	1.000	1.000
metaphorical - personification	0.844	100.625	83.083	0.399	1.000	1.000
metaphorical - representing	1.398	100.625	80.078	0.162	1.000	1.000
metaphorical - direct referencing	-0.644	100.625	122.667	0.520	1.000	1.000
personification - representing	0.180	83.083	80.078	0.857	1.000	1.000
personification - direct referencing	-1.127	83.083	122.667	0.260	1.000	1.000
representing - direct referencing	-1.335	80.078	122.667	0.182	1.000	1.000

* p < .05, ** p < .01, *** p < .001

Table 6 | *Dunn's Post Hoc Comparisons – Strategy in Nouns – Analysis 4*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
acting - drawing	2.352	59.452	32.929	0.019 *	0.280	0.261
acting - metaphorical	-0.261	59.452	63.125	0.794	1.000	1.000
acting - personification	1.983	59.452	40.917	0.047 *	0.711	0.616
acting - representing	3.078	59.452	38.202	0.002 **	0.031 *	0.031 *
acting - direct referencing	0.007	59.452	59.333	0.994	1.000	1.000
drawing - metaphorical	-1.865	32.929	63.125	0.062	0.933	0.747
drawing - personification	-0.650	32.929	40.917	0.516	1.000	1.000
drawing - representing	-0.500	32.929	38.202	0.617	1.000	1.000
drawing - direct referencing	-1.481	32.929	59.333	0.139	1.000	1.000
metaphorical - personification	1.489	63.125	40.917	0.137	1.000	1.000
metaphorical - representing	1.844	63.125	38.202	0.065	0.979	0.747
metaphorical - direct referencing	0.192	63.125	59.333	0.848	1.000	1.000
personification - representing	0.321	40.917	38.202	0.748	1.000	1.000
personification - direct referencing	-1.104	40.917	59.333	0.269	1.000	1.000
representing - direct referencing	-1.369	38.202	59.333	0.171	1.000	1.000

* p < .05, ** p < .01

Table 7 | *Dunn's Post Hoc Comparisons – Strategy-Analysis 5*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
acting - drawing	2.653	111.139	59.000	0.008 **	0.048 *	0.040 *
acting - personification	2.256	111.139	75.917	0.024 *	0.145	0.096
acting - representing	4.543	111.139	73.328	< .001 ***	< .001 ***	< .001 ***
drawing - personification	-0.727	59.000	75.917	0.467	1.000	1.000
drawing - representing	-0.748	59.000	73.328	0.454	1.000	1.000
personification - representing	0.173	75.917	73.328	0.863	1.000	1.000

* p < .05, ** p < .01, *** p < .00

Table 8 | *Dunn's Post Hoc Comparisons – Strategy in Nouns - Analysis 5*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
acting - drawing	2.332	55.881	31.643	0.020 *	0.118	0.099
acting - personification	1.930	55.881	39.250	0.054	0.322	0.215
acting - representing	3.030	55.881	36.595	0.002 **	0.015 *	**0.015** *
drawing - personification	-0.672	31.643	39.250	0.502	1.000	1.000
drawing - representing	-0.509	31.643	36.595	0.610	1.000	1.000
personification - representing	0.341	39.250	36.595	0.733	1.000	1.000

* p < .05, ** p < .01

Table 9 | *Dunn's Post Hoc Comparisons - Semantic Category in Nouns- Exploratory Analysis*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
animate entity - manipulable	-3.384	60.368	94.361	< .001 ***	0.007 **	0.006 **
animate entity - psychological	-2.647	60.368	119.125	0.008 **	0.081	0.065
animate entity - unmanipulable	-0.347	60.368	63.426	0.729	1.000	1.000
animate entity - bodypart	-2.173	60.368	115.333	0.030 *	0.298	0.179
manipulable - psychological	-1.119	94.361	119.125	0.263	1.000	1.000
manipulable - unmanipulable	3.573	94.361	63.426	< .001 ***	0.004 **	0.004 **
manipulable - bodypart	-0.831	94.361	115.333	0.406	1.000	1.000
psychological - unmanipulable	2.578	119.125	63.426	0.010 **	0.100	0.070
psychological - bodypart	0.118	119.125	115.333	0.906	1.000	1.000
unmanipulable - bodypart	-2.095	63.426	115.333	0.036 *	0.362	0.181

* p < .05, ** p < .01, *** p < .001

Table 10 | *Dunn's Post Hoc Comparisons - Semantic Category in Nouns*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
animate entity - manipulable	-3.393	59.368	91.806	< .001	0.002	**0.001**
animate entity - unmanipulable	-0.404	59.368	62.757	0.686	1.000	0.686
manipulable - unmanipulable	3.525	91.806	62.757	< .001	0.001	**0.001**

* p < .05, ** p < .01

Table 11 | *Dunn's Post Hoc Comparisons - Semantic Category in Verbs*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
action with obj - action without obj	3.219	86.510	62.307	0.001	0.004	0.004
action with obj - psychological	-0.308	86.510	90.667	0.758	1.000	0.758
action without obj - psychological	-2.186	62.307	90.667	0.029	0.086	0.058

* p < .05, ** p < .01

Table 12 | *Dunn's Post Hoc Comparisons – Effects of Strategy in the Group of Animate Entities*

Comparison	z	W_i	W_j	p	p_{bonf}	p_{holm}
acting - personification	1.799	17.000	9.667	0.072	0.216	0.144
acting - representing	2.541	17.000	5.250	0.011	0.033	0.033
personification - representing	1.433	9.667	5.250	0.152	0.456	0.152