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CRITICAL REVIEW

Nonliteral Language in Alzheimer Dementia: A Review

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Abstract

The use of nonliteral language in clinical assessment, especially testing the patients' ability to interpret proverbs, has a long tradition in psychiatry. However, its diagnostic sensitivity and specificity in dementias is not yet clear. The aim of this review article is to examine the current evidence on nonliteral/figurative language (proverb, metaphor, metonymy, idiom, irony, sarcasm) comprehension in Alzheimer's disease and related disorders. A comprehensive literature search identified 25 studies (16 proverb, 3 metaphor, 0 metonymy, 5 idiom, 3 sarcasm) on nonliteral language comprehension in dementia. Studies predominantly indicate a deficit. Most studies investigated Alzheimer's dementia. Applied correctly, nonliteral language is a worthwhile diagnostic tool to evaluate language and abstract thinking in dementias. During assessment, familiarity testing (e.g., by asking ''are you familiar with the proverb XY'') is obligatory. Still, future research is needed in several areas: evidence on decline of nonliteral language over the course of the illness is limited. So far, almost no studies delineated proverb comprehension in high risk populations such as patients with mild cognitive impairment. Currently, there is a lack of studies addressing performance in direct comparison to relevant differential diagnosis like older-age depression, delirium, brain lesion, or other psychiatric conditions. (*JINS*, 2011, *17*, 207–218)

Keywords: Figurative, Thought disorder, Metaphor, Idiom, Irony, Sarcasm

INTRODUCTION

In clinical routine and research, abstract thinking difficulties are often tested by assessing the patient's ability to explain and understand nonliteral, "figurative" expressions such as proverbs, metaphors, and idioms (Chapman et al., 1997; Kempler, Van Lancker, & Read, 1988). Especially in the case of proverbs, this diagnostic procedure has a long tradition within psychiatry and neurology (Andreasen, 1977; Gorham, 1961; Hadlich, 1931; Thoma & Daum, 2006; Wegrocki, 1940). However, although applied routinely, there is no current consensus on the diagnostic reliability and specificity of this procedure in dementias. This is unfortunate, since complex language deficits may represent interesting diagnostic tools for dementias: language deficits occur early in the course of Alzheimer's disease (AD), and performance on verbal tasks was suggested as an important diagnostic criterion for both AD and mild cognitive impairment (MCI) in a recent review (Taler & Phillips, 2008).

The past decade brought an enormous increase of knowledge on the cognitive and brain function processes behind comprehension of nonliteral language (NL language) (Kacinik, & Chiarello, 2007; Rapp, 2009, 2011; Schmidt, Kranjec, Cardillo, & Chatterjee, 2010).

Several new studies addressed nonliteral language comprehension processes in patients with dementia, especially of the Alzheimer subtype. However, to our knowledge, no current review has summarized the findings. Consequently, the aim of this study is to review studies addressing nonliteral language comprehension in dementia. It includes work on metaphors, metonymies, proverbs, idioms, and irony/sarcasm.

LINGUISTIC ASPECTS: NONLITERAL LANGUAGE AND ITS COMPREHENSION PROCESSES

Nonliteral language (often called "figurative" language) is a heterogeneous linguistic entity of speech forms that go beyond the literal meaning of the words and requires the ability to process more than the literal meaning of an utterance to grasp the speaker's intention in a given context. Although several definitions exist for nonliteral language, there is general consensus that metaphors, proverbs, idioms, irony, sarcasm, and metonymy are among the most important

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types of nonliteral language. A widely accepted—but not precisely defined—approach to classify nonliteral language is the distinction between salient (sometimes called "fossilized") and nonsalient ("novel") nonliteral expressions. A salient expression is "frequently" used in everyday language, whereas a "novel" expression is not. It is generally accepted that the cognitive processes between salient and nonsalient expressions differ (Giora, 2003; Glucksberg, 2003), although the exact nature of these differences are still subject of debate and investigation (Giora, 2007). An important remark is that salience is not identical with familiarity in an individual subject. In other words, an individual may be not familiar with even a very "popular," salient nonliteral expression such as, for example, "kick the bucket" (which in English is metaphorical for "to die"). As many nonliteral expressions are not self-explaining, this means that the individual, if unfamiliar with the expression, is often unable to access its meaning. This may sound trivial, but is significant if differences in familiarity are not considered in studies comparing subject populations.

Newer research demonstrates that the various different forms of nonliteral language differ in their structure, communicative function, and processing demands (Colston & Gibbs, 2002; Giora, 2007; Rapp, 2009, 2011; Rundblad & Annaz, 2010; Winner & Gardner, 1993; Zaidel, Kasher, Soroker, & Batori, 2002). Correspondingly, brain imaging studies investigating the functional neuroanatomy of different nonliteral expressions in healthy subjects show activation differences between different types of nonliteral language (Ahrens et al., 2007; Eviatar & Just, 2006; Schmidt & Seger, 2009; Yang, Edens, Simpson, & Krawczyk, 2009).

METHODS

The aim of this work is a systematic review of the current evidence on nonliteral language comprehension in Alzheimer's disease (AD) and related disorders. Relevant literature was identified using the databases PsychInfo and PUBMED and the search terms metaphor, idiom, proverb, metonymy, irony, sarcasm in combination with Alzheimer, dementia, or mild cognitive impairment.

RESULTS

Our literature search identified 24 studies on nonliteral language in dementia (Table 1). Of these 24 studies, 20 reported data in Alzheimer's dementia. Half of the studies report comparisons with patient samples other than AD [frontotemporal dementia (FTD) ($n = 4$), vascular dementia ($n = 4$), or schizophrenia ($n = 2$), see Table 1]. One additional study (Campanha et al., 2008; $n = 60$ AD patients) was excluded because it was only published as a conference abstract. Astonishingly, no studies regarding mild cognitive impairment could be identified. First, the literature was analyzed with reference to linguistic aspects. In the second part of this review, disease specific aspects are discussed.

Metaphor

Metaphors (such as "life is a journey") are used for conceptualizing and making expressible relevant parts of our lives that are otherwise difficult to explain (Lakoff & Johnson, 1980). Taken literally, metaphoric statements are mostly wrong (Glucksberg, 2003). The meaning of a metaphor is suggested through association and comparison of similarities between different expressions that are not stated explicitly. Beyond semantic and word-by-word analysis, understanding the figurative meaning of a metaphor requires mental linkage of different category domains normally not related to each other (Glucksberg, 2003; Rapp, Leube, Erb, Grodd, & Kircher, 2004).

Several imaging and lesion studies investigated the functional neuroanatomy of metaphor comprehension in healthy subjects (Chen, Widick, & Chatterjee, 2008; Hillert, & Buracas, 2009; Mashal, Faust, Hendler, & Jung-Beeman, 2005; Rapp, Leube, Erb, Grodd, & Kircher, 2004, 2007; Schmidt & Seger, 2009; Shibata, Abe, Terao, & Miyamoto, 2007; Stringaris, Medford, Giampietro, Brammer, & David, 2007) and brain lesioned patients (Gagnon, Goulet, Giroux, & Joanette, 2003; Rinaldi, Marangolo, & Baldassarri, 2004; Zaidel et al., 2002). Results indicate that a predominantly left-lateralized fronto-temporal network with some right hemisphere involvement is crucial in metaphor appreciation (Rapp, 2011). Lesion studies and hemifield research (Anaki, Faust, & Kravetz, 1998; Faust & Mashal, 2007; Kacinik & Chiarello, 2007; Schmidt, DeBuse, & Seger, 2007) indicate that laterality within this network is possibly task-dependent: right hemisphere lesioned subjects have difficulties in matching orally presented metaphors with an appropriate picture (Gagnon et al., 2003; Hillekamp, Knobloch, & Buelau, 1996; MacKenzie, Begg, Brady, & Lees, 1997; Winner & Gardner, 1977), whereas they give adequate verbal descriptions of metaphors (Giora, Zaidel, Soroker, Batori, & Kasher, 2000; Winner & Gardner, 1977). In contrast, left hemisphere-damaged patients often offer "concrete" or "literal" verbal explanations of the metaphors in most studies (Burgess & Chiarello, 1996; Rapp, 2011; Winner & Gardner, 1977). These findings are of potential relevance for testing procedures: while multiple choice tasks are clearly a bihemispheric function, this situation is less clear for verbal explanation approaches.

So far, three studies investigated the comprehension of metaphors in Alzheimer's dementia (Amanzio, Geminiani, Leotta, & Cappa, 2008; Papagno, 2001; Winner & Gardner, 1977). In a seminal study of the field, Winner and Gardner (1977) investigated the comprehension of frequently used metaphoric expressions (such as "lend a hand"). In their study, AD patients were seriously impaired in selecting the picture representing the correct metaphoric meaning of an utterance out of four alternatives and in explaining the meaning of a metaphor with own words. However, in this study a small sample of only seven patients was investigated.

In a prospective study, Papagno (2001) investigated the comprehension of metaphors (taken from Papagno et al., 1995) over a time period of 6–8 months. Her paradigm was a verbal explanation task. The decrement in metaphor comprehension,

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Table 1. Studies on nonliteral language in AD and other dementia

Author	Year	Type of NL language	Salience of stimuli	Task	Study design[1]	Language	No. of Alzheimer patients	MMSE[16]	No. of other patients	No. of healthy control subjects	Significance[2]
Elmore & Gorham	1957	Proverb	High	Verbal explanation plus multiple choice	Cross	English	?	-[14]	25 organic, 26 SCZ	25	$p < .001$
Winner & Gardner	1977	Metaphor	High	Sentence-to-picture matching	Cross	English	7	-[14]	22 RHD, 35 LHD	10	$p < .05$
Code et al.	1987	Proverb	High	Verbal explanation	Cross	English	18	-[14]	6 vascular dementia	-[3]	-[3]
Kempler et al.	1988	Proverb, idioms	High	Sentence-to-picture matching	Cross	English	29	23,7/17,5/<15	—	43	$p < .01$
Treves et al.	1990	Proverb	High	Verbal explanation	Cross	Hebrew		-[14]	89 dementia, either Alzheimer or vascular	344	$p < .001$[4]
Heinik & Aharon-Peretz	1993	Proverb	High	Verbal explanation	Cross	Hebrew	11	18,7	10 vascular dementia	9	Yes
Lafleche & Albert	1995	Proverb	High	Verbal explanation	Cross	English	20	25,1		20	n.s.
Brundage et al.	1996	Proverb	Low/high	Verbal explanation	Cross	English	10	10 – 25[17]	10 aphasic, 10 RHD	-[3]	-[3]
Chapman et al.	1997	Proverb	Low/high	Verbal explanation & multiple choice	Cross	English	10	22,3	10 fluent aphasia	10	
Chapman et al.	1998	Proverb	High	Verbal explanation plus multiple choice	Cross	English	10	22	10 aphasic	10	Yes
Moretti et al.	2000	Proverb	?	Gorham proverb test[5]	Cross	Italian[6]	20	23,2		None	-[3]
Moretti et al.	2001a	Proverb	?	Gorham proverb test[5]	Long	Italian[6]	4	19	4 FTD, 4 ALS[13]	4	Not reported
Papagno	2001	Idioms, metaphor	High	Verbal explanation	Long	Italian	39	-[14]		None	No control
Moretti et al.	2002	Proverb	?	Gorham proverb test[5]	Cross	Italian	30	21	30 fronto-lobar disease, 30 vascular dementia		
Papagno et al.	2003	Idioms	High	Sentence-to-picture matching	Cross	Italian	15	-[14]		15	$p < .0001$[9]
Moretti et al.	2005	Proverb	?	Gorham proverb test[5]	Long	Italian	0	22,4	144 subcortical vascular dementia	None	No control
Amanzio et al.	2008	Metaphor, idiom	Low/high	Verbal explanation	Cross	Italian	20	21,8		20	n.s./$p < .00001$[10]
Kosmidis et al.	2008	Sarcasm	—	TASIT-GR[8]	Cross	Greek	0	-[14]	9 fronto-temporal dementia, 28 Schizophrenia	10	
Santos et al.	2008	Proverb	High	STADP[11]	Cross		Portuguese[12]	46		14	$p < .001$[13]
Kipps et al.	2009	Sarcasm	—	TASIT[7]	Cross	English	9	25	26 FTD	16	n.s.
Baez et al.	2009	Proverb	High	Verbal explanation	Cross	Spanish	30	22,8		30	$p < .001$
Rassiga et al.	2009	Idioms	Mainly high	Sentence-to-picture matching plus sentence to word matching	Cross	Italian	15	All > 17[17]		15	$p < .008$[9]

(Continued)

Table 1. Continued

Author	Year	Type of NL language	Salience of stimuli	Task	Study design[1]	Language	No. of Alzheimer patients	MMSE[16]	No. of other patients	No. of healthy control subjects	Significance[2]
Rankin et al.	2009	Sarcasm	—	TASIT[7]	Cross	English	27	22,2	20 fronto-temporal dementia, 11 semantic dementia, 4 progressive non-fluent aphasia, 6 corticobasal degeneration, 9 progressive supranuclear palsy	13	n.s.
Santos et al.	2009	Proverb	High	STADP[11]	Cross		Portuguese[12]	28	24,7	63	

Note. AD = Alzheimer's disease; Organic = organic brain damage; SCZ = schizophrenia; LHD = left hemisphere brain damage; RHD = right hemisphere brain damage; FTD = fronto-temporal dementia; ALS = amyotrophic lateral sclerosis; n.s. = not significant; TASIT = the Awareness of Social Inference test.
[1]Cross = cross-sectional, Long = longitudinal.
[2]AD patients relative to healthy control subjects.
[3]No control group.
[4]For the whole patient group vs. controls.
[5]Paper reports use Gorham proverb test in 1968 original form. However, likewise an Italian version was used.
[6]Likewise, no information reported.
[7]TASIT sarcasm test (McDonald et al., 2006).
[8]Greek Version of the TASIT sarcasm comprehension test.
[9]For both tasks.
[10]Not significant for conventional metaphors and idioms, $p < .00001$ for new metaphors.
[11]Screening Test for Alzheimer's Disease with Proverbs (STADP, Santos et al., 2009). The STADP has 3 subtests.
[12]Not mentioned in an explicit manner, but likewise Portuguese.
[13]For the total score of the STADP, significant results relative to controls also in all subtests except stage b (executive functions).
[14]Not reported.
[15]For all subtests (recognizing, interpreting, abstracting).
[16]Mini-mental state examination (Folstein et al., 1975), reported mean value for patients. The study by Kempler et al. (1988) reports three patient groups with different severity levels.
[17]Range (No mean value reported).

but not idiom comprehension, was significant after this time period. Only conventional, that is frequently used, metaphors were used. There was no healthy control group. The question whether the used metaphors are salient (frequently used in everyday language) is of relevance since the neural correlates for nonsalient metaphoric stimuli possibly differ (Ahrens et al., 2007; Schmidt & Seger, 2009; Yang et al., 2009; Yang, Fuller, Khodaparst, & Krawczyk, 2010), and possibly a greater extent of right hemisphere recruitment could be required for their comprehension process (Giora et al., 2000; Giora, 2007; Schmidt et al., 2010). Amanzio et al. (2008) compared comprehension of conventional metaphors and new metaphors in a sample of 20 AD patients with a mean Mini-Mental State Examination (MMSE) score (Folstein, Folstein, & McHugh, 1975) of 22. The same stimuli as in Papagno (2001) were used. Relative to an age-matched control group, AD patients were only significantly impaired for new metaphors, but not for conventional metaphors and idioms.

Metonymy

Metonymy is a frequent form of nonliteral language, in which one expression is used to refer to the standard referent of a related one (for example "Kremlin" for "the Russian government") (Lakoff & Johnson, 1980; Panther & Radden, 1999).

Newer linguistic research highlights the cognitive differences in the comprehension process between metonymy and metaphor. Whereas metaphor requires the mapping across two semantic domains, metonymy requires only one semantic domain (Annaz et al., 2009; Rapp et al., 2010; Rundblad, & Annaz, 2010). No studies have yet addressed the comprehension of metonymy in AD or other dementias.

Proverbs

The highest proportion of studies on NL language in Alzheimer's disease investigated the comprehension of proverbs (Table 1; Báez, Mendoza, Reyes, Matallana, & Montañés, 2009; Brundage & Brookshire, 1995; Chapman et al., 1997; Chapman, Highley, & Thompson, 1998; Code & Lodge, 1987; Elmore & Gorham, 1957; Heinik & Aharon-Peretz, 1993; Kempler et al., 1988; Lafleche & Albert, 1995; Moretti, Torre, Antonello, & Cazzato, 2000, 2001a, 2001b; Moretti, Torre, Antonello, Cazzato, & Bava, 2002; Moretti et al., 2005; Santos, Sougey, & Alchieri, 2009; Treves, Ragolsky, Gelernter, & Korczyn, 1990). Proverbs are simple, popularly known sayings based on a common sense or practical experience. Some, but not all proverbs are metaphors.

In analogy to metaphor, the distinction between verbal explanation and multiple choice (MC) tasks is of relevance. Whereas most studies used verbal explanation tasks (Brundage, 1993; Code & Lodge, 1987; Elmore & Gorham, 1957; Heinik & Aharon-Peretz, 1993; Lafleche & Albert, 1995; Treves et al., 1990) or multiple choice (Kempler et al., 1988), few studies applied both tasks in their sample (Chapman et al., 1997, 1998). In multiple choice tests, AD patients are significantly impaired. In the study by Kempler et al. (1988), 29 AD patients performed significantly worse relative to 43 healthy controls. In everyday clinical routine, testing proverb explanation is much quicker than a multiple choice task. There is some evidence from the study by Chapman et al. (1997) that the impairment in proverb explanation is less severe compared with MC. However, their results rely on only 10 patients and a low number of stimuli. Few studies compared proverb explanation in AD with healthy controls. In a historical study, Elmore and Gorham (1957) found significantly impaired proverb comprehension on the Gorham proverbs test (Gorham, 1956). However, their group of "organics" is not further specified (Fogel, 1965). Another study has a similar limitation. Treves et al. (1990) applied a proverb explanation task to a group of 89 dementia patients and found a $p < .001$ significance level relative to healthy control subjects. However, their study did not discriminate between AD and vascular dementia. Other proverb studies predominantly had small samples or had no healthy control group (Brundage & Brookshire, 1995; Code & Lodge, 1987; Moretti et al., 2002, 2005) (Table 1). Future research should consider findings from newer linguistic research. The perhaps most important aspect is familiarity of proverbs. It is now clear that comprehensibleness of proverbs interdepends with their familiarity (Nippold & Haq, 1996) that is, whether the subject "knows" the proverb or not (Uekermann, Thoma, & Daum, 2008). Research in healthy subjects and patients indicates that familiar proverbs are easier to interpret (Penn, Jacob, & Brown, 1988). One explanation given in the literature is that successful recognition of familiar nonliteral expressions likewise involves perception of an "overall pattern" (Gibbs, 1980; Horowitz & Manelis, 1973; Lieberman, 1963; Osgood & Housain, 1974), whereas, in contrast, comprehension of proverbs that are novel to the subject can require extensive semantic association processes and referring to general world knowledge.

Few studies addressed this effect of proverb familiarity on comprehension in AD patients. Chapman et al. (1997) applied two tasks to a sample of 10 AD patients: verbal explanation and multiple choice. According to normative data collected in a previous study by Delis, Kramer, and Kaplan (1984), five proverbs were "familiar", *versus* five "unfamiliar" ones. Results showed a familiarity × diagnosis interaction: Whereas in the verbal explanation task AD patients were significantly impaired only for unfamiliar, but not familiar proverbs AD patients were impaired in the multiple choice task only in familiar, but not unfamiliar proverbs. Their finding that AD patients have difficulties especially with verbal explanation of unfamiliar proverbs is also strengthened by a study of Brundage & Brookshire (1995), who found a significant effect of proverb familiarity on comprehension in AD patients. In their study, AD patients gave verbal description of the proverbs and the answer was rated using an "adequacy score" (Brundage & Brookshire, 1995). The maximum possible adequacy score for a proverb was 20. Significantly associated with familiarity, the scores for the different proverbs ranged between 20 (indicating that all 10 AD subjects gave perfect descriptions) and 0 (indicating that none of the subjects gave a

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meaningful description). This result indicates that proverb familiarity is a strong predictor of comprehension performance in AD. However, several factors limit the generalizability of these findings. First, the study has no control group, although other research from the same group indicates that healthy subjects show a similar effect (Qualls & Harris, 2003; Brundage & Brookshire, 1995; Ulatowska et al., 1998; Roos & Lewis, 1962). The familiarity for the proverbs was not directly measured in the study population. Instead, normative data were used (Delis et al., 1984). This point is of relevance as marked inter-individual differences exist in people's familiarity with individual proverbs (Haynes, Resnick, Dougherty, & Althof, 1993; Penn et al., 1988; Van Lancker, 1990). As well, the number of applied stimuli (five in each condition) is low in the study by Chapman. A rational approach for future research and routine concerning proverb familiarity could be to first directly ask the patient if he/she is familiar with the proverb and then assess comprehension (Thoma et al., 2009; Uekermann et al., 2008).

Three recent studies from Brazil investigated proverb comprehension in larger samples of AD patients. Campanha and colleagues (2008) investigated comprehension of popular Brazilian proverbs in a comparatively large sample of 60 AD patients and 60 healthy controls. Results exhibited a significant decrease in AD for recognizing, interpreting, and abstracting proverbs. However, their research is so far only published as a conference abstract. Santos et al. (2008, 2009) investigated the performance of AD patients and older subjects on the Screening Test for Alzheimer's Disease with Proverbs (STADP) (Santos et al., 2009). This screening test consists of six cards from the "memory game of Proverbs" (Santos, Carvalho, Bastos, & Sougey, 2005). In three subtests, subjects need to recognize, interpret, and recall proverb meanings. In their first study, 14 AD subjects were significantly impaired in the STADP total score, but not in the subtest for interpreting proverbs. All subtests were significantly correlated with the MMSE (Folstein et al., 1975). The latter finding was replicated in a different sample of 28 AD subjects and 63 healthy controls (Santos et al., 2009).

Idioms

Idioms form a large group both in terms of syntactic and semantic characteristics. Idioms are structurally "frozen," that means they are fixed expressions. Some idioms—like metaphors—can be understood by comparison of the semantic entities within, whereas others cannot (like "kick the bucket", which in English language is an idiomatic expression for "to die"). Five studies have as yet investigated idiom comprehension in Alzheimer dementia (Amanzio et al., 2008; Kempler et al., 1988; Papagno, 2001; Papagno, Lucchelli, Muggia, & Rizzo, 2003; Rassiga, Lucchelli, Crippa, & Papagno, 2009).

In contrast to the proverb studies, most idiom studies used multiple choice tasks. In a study with 29 AD patients, Kempler et al. (1988) did not differentiate between idioms and proverbs but found a more severe deficit for familiar expressions relative to controls. However, the patient group was significantly impaired as well in understanding literal control stimuli. This illustrates the importance of literal control stimuli, which are unfortunately missing in five other studies on proverb comprehension (Table 1).

Papagno et al. (2003) tested nonambiguous opaque idioms (like "to be at the seventh sky"), a specific class of idioms in which it is not possible to figure out their meanings from the individual words. In their study, they used a sentence to picture matching paradigm. AD probands with a mild degree of cognitive decline (MMSE 16–22) were significantly impaired relative to a comparison group, when they had to choose between two pictures, one representing the figurative and one the literal one. However, the performance improved when the picture with the literal meaning was replaced by one representing an unrelated situation.

In another study, the same workgroup (Rassiga et al., 2009) investigated comprehension of ambiguous idioms in 15 patients with mild probable AD. Two tasks were used: In the first, patients had to select the correct meaning out of four pictures while in the second they chose among four words. For both tasks, the alternatives were the picture/word corresponding to the figurative meaning, a semantic associate (picture/word) to the last word of the idiom, and two unrelated alternatives. AD patients were significantly impaired in both tasks, however the effect was stronger in the sentence to picture matching task. The authors concluded that AD patients, like subjects with aphasia, have difficulties as well in the "easier" category but that other factors than semantic language comprehension could have an impact. Such a result would be consistent with aphasic subjects (Papagno & Caporali, 2007). As well, extralinguistic executive functions play a role in these tasks.

Only one study used a verbal explanation task. Papagno (2001) investigated the comprehension of 20 idiomatic phrases in a prospectively designed study in 39 patients with mild to moderate AD. Her study has no control group, but normative data from 321 healthy controls in the task are available (Novelli et al., 1986). After 6 months follow-up, no significant impairment was present for idioms. However, the same sample showed a significant decrease in metaphors.

Irony and Sarcasm

In verbal irony the speaker uses words that express something other—in most cases the opposite—of what he literally says (Katz, Blasko, & Kazmerski, 2004). To detect irony, the listener hence needs to understand not only that the speaker does not mean exactly what she/he said, but also that she/he does not expect to be taken literally (Blasko & Kazmerski, 2006; Colston & Gibbs, 2002). Consequently, relative to other types of nonliteral language, the comprehension of irony involves additional cognitive processes like second-order theory of mind (TOM) processing (Blasko & Kazmerski, 2006; Rapp, Mutschler, et al., 2010). Sarcasm is mostly defined as a severe form of irony often intended to insult or wound. In sarcastic expressions the speaker says the opposite of what he

means (for example "this is just great" after something bad happens). Sarcasm can be difficult to grasp in written form and is easily misinterpreted. Comprehension of irony relies on both cerebral hemispheres (Eviatar & Just, 2006; Schmidt et al., 2010; Zaidel et al., 2002) and ventral fronto-medial cortex (Rapp, Markert, Erb, & Grodd, 2010; Shamay-Tsoory & Aharon-Peretz, 2007). Patients with AD are impaired in such second-order theory of mind processes (Cuerva et al., 2001).

To our knowledge, three studies have yet investigated irony comprehension in Alzheimer or other dementia (Rankin et al., 2009; Kipps, Nestor, Acosta-Cabronero, Arnold, & Hodges, 2009). Two used identical stimulus material, the Awareness of Social Inference test (TASIT; McDonald, Flanagan, Rollins, & Kinch, 2003), whereas the third study translated the same test into Greek language (Kosmidis, Aretouli, Bozikas, Giannakou, & Ioannidis, 2008). During the TASIT, subjects watch short video vignettes in which professional actors interact. After that, the subject has to answer four yes/no questions about the actions, thoughts, words, and emotions of the characters. Two subtests ("simple sarcasm" and "severe sarcasm") include ironic stimuli.

Kipps et al. (2009) applied the TASIT to a sample of nine early AD patients with a mean MMSE score of 25 and did not find a significant impairment relative to a control group. Rankin et al. (2009) applied the same test to a sample of 27 AD patients (mean MMSE 22.2) and found no significant impairment relative to a control group. In both studies other dementia subtypes with comparable MMSE scores (FTD in Kipps et al., 2009), semantic dementia in Rankin et al. (2009) showed a more severe impairment in the severe sarcasm condition, a finding that could possibly be explained by a more pronounced frontal lobe deficit in these disorders. These findings at least point against an early severe impairment of irony detection in AD. Another study (Kosmidis et al., 2009) applied a Greek version of the TASIT to a sample of nine patients with FTD. Relative to a healthy control group, these subjects were significantly impaired in the "minimal," but not the "severe sarcasm" subtest.

These findings are surprising in the context of recent imaging studies which compared the functional neuroanatomy of irony and metaphor comprehension. Relative to other types of nonliteral language, the comprehension of irony involves additional cognitive processes like second order theory of mind processing (Blasko & Kazmerski, 2006). Whereas first-order TOM is sufficient for understanding metaphors, an attribution of second-order representations, that is the ability to reflect on the speaker's thought about an attributed thought, is needed for correct interpretation of irony (Happé, 1996; Filippova & Astington, 2008). Other research demonstrates that patients with AD are impaired in second order theory of mind processes (Cuerva et al., 2001). As well, relative to comprehension of salient metaphors, the comprehension of irony relies more on bilateral brain processes (Eviatar & Just, 2006; Giora et al., 2000; Zaidel et al., 2002; Schmidt et al., 2010) and ventral fronto-medial cortex (Rapp et al., 2010; Shamay-Tsoory & Aharon-Peretz, 2007).

A few factors independent of unimpaired irony comprehension in early AD may contribute to the negative results. Unlike most other tests of sarcasm performance (Channon et al., 2007; Shamay-Tsoory, Tomer, & Aharon-Peretz, 2002, 2005; Shibata, Toyomura, Itoh, & Abe, 2010; Zaidel et al., 2002) the stimuli in the TASIT are arguably more "less artificial" (Kipps et al., 2009) than written ironic stimuli, and may more effectively incorporate affective paralinguistic cues as to the speaker's real intention (Kipps et al., 2009).

IMPLICATIONS FOR CLINICAL PRACTICE AND FURTHER RESEARCH

The significance of nonliteral language as diagnostic tool interdepends with its applicability in everyday clinical routine and its diagnostic reliability and specificity. However, astonishingly few studies have directly addressed these points.

In "bedside" investigations, the applicability of verbal explanation tasks is superior relative to multiple choice tasks, since verbal explanation of nonliteral expressions can be tested within seconds. During evaluation, the patient is asked to explain the meaning of a nonliteral expression with own words and the answer is then rated for its concreteness and other types of formal thought disorder (Brundage & Brookshire, 1995; Gorham, 1956; Wechsler, 1976). This diagnostic procedure has a long tradition within psychiatry (Finckh, 1906; Farrar, 1906; Benjamin, 1944; Gorham, 1956; Goldstein & Salzman, 1965; Andreasen, 1977), but is nevertheless under scrutiny for its reliability. Whereas some studies in younger populations indicated poor retest-reliability (Andreasen, 1977; Burgos, 1986), other studies found better reliability (Reich, 1981) and the same caveat holds for diagnostic validity (Sander & Greenberg, 1968; Andreasen, 1977). That is, diagnostic reliability and validity are not necessarily poor, but remain widely undetermined especially in geriatric populations. The quality of the testing procedure could be improved, however, if clinicians consider some points:

One important point is the nonliteral language test material used for the assessment. Proverbs, metaphors, and idioms are probably likewise equally suitable, whereas testing irony comprehension in a verbal explanation approach is from our perspective more difficult. As highlighted above, salience and familiarity of nonliteral expressions are important moderators of performance and should be considered while selecting the nonliteral expressions used for testing. High salience indicates that the expression is frequently used in a population, whereas familiarity indicates that the individual "knows" (is familiar with) the expression. For diagnostics in clinical routine, we recommend the use of familiar stimuli, although in research contexts unfamiliar stimuli can be interesting as well. We would recommend testing familiarity of the subject for any stimulus under investigation. Familiarity is a predictor of performance in nonliteral language comprehension in a sense that performance decreases and is less predictable in with unfamiliar nonliteral idioms (Nippold & Taylor, 2002) and proverbs (Nippold & Haq, 1996;

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Thoma et al., 2009). A high salience of an expression makes it more likely that an individual "knows" an expression, but it is no proof. In clinical practice, one worthwhile procedure to test familiarity could be to first ask for the familiarity with a nonliteral expressions (e.g., "are you familiar with the proverb . . . ") and then test comprehension (Tseng & Streltzer, 2008; Uekermann et al., 2008).

Whether it makes sense to use unfamiliar nonliteral expressions in the assessment is currently still controversial. From our perspective, it is not meaningful to test comprehension of expressions that are both unfamiliar to the subject and not self explanatory (like "kick the bucket," which in English is a salient metaphoric idiom for "to die") outside a research context. This is because a correct interpretation is difficult (and often impossible to reach) in unfamiliar, not self-explanatory idiomatic expressions and proverbs. If the term has a plausible literal interpretation—which is true in many frequently used "test proverbs"—a literal interpretation is not the result of a failure of abstract thinking, but instead the only plausible interpretation. This cautionary remark is not trivial, as a remarkable proportion of "test proverbs" given in textbooks have a plausible literal interpretation. In the research context, the use of unfamiliar ("novel"), self-explanatory metaphors can be interesting as the cognitive demand for processing these stimuli is higher and less confounded by familiarity effects (Rapp, 2011).

An alternative to testing by verbal explanation is matching the meaning of nonliteral expressions with given alternatives. The disadvantages of this approach in clinical routine are that only a small number of tests are available and the execution takes more time. Of note, the availability of NL language tests for AD diagnosis is limited. In English language, the Proverb subtest of the Delis-Kaplan Executive Function System (D-KEFS) is available (Delis, Kaplan, & Kramer, 2001). The D-KEFS Proverb Test consists of eight sayings that are presented in two conditions, free inquiry and multiple choice. The most frequently applied test in English language is Gorham's proverb test (Gorham, 1956). Both tests are not validated for dementia. This limitation is also true for multiple choice tests in other languages such as Italian (Novelli et al., 1986) and German (Barth & Küfferle, 2001; Jäger & Althoff, 1983; Uekermann et al., 2008). The situation is best for Portuguese, where the STADP (Santos et al., 2009) is available and evaluated for dementia. Normative data on populations with older age exist only for the tests by Delis et al. (2001), Uekermann et al. (2008) and Jäger and Althoff (1983). Testing sarcasm and irony "bedside" is difficult as well. The TASIT (McDonald et al., 2003) is available in English and Greek language, but is too time-consuming for everyday clinical routine and not validated for dementia as well.

A question of clinical relevance is whether nonliteral language is a promising tool for differential diagnosis of AD. Although many textbooks recommend the use of proverbs during assessment, the method has been criticized for its specificity.

For other important differential diagnoses, the situation is even less clear. Doubtlessly the most studies for proverb explanation in clinical samples exist for *schizophrenia*. The first experimental study was published by Wegrocki (1940). Since then, more than 105 experimental investigations addressed nonliteral language in Schizophrenia (Rapp & Schmierer, 2010). Evidence for a comprehension deficit exists for all types of nonliteral language (Hensler, 2009; Rapp, 2009). However, data on comparisons relative to AD is scarce. One recent study (Kosmidis et al., 2008) compared sarcasm comprehension between FTD and schizophrenia and found a less global deficit in FTD relative to Schizophrenia. Still, such a result may highly depend on the progression of dementia. The benefit for differential diagnosis between these diagnoses must so far be considered to be low.

The differential diagnosis between AD and *depression* is often difficult and sometimes confounded by comorbid depression in patients with beginning dementias. Nonliteral language impairment could theoretically separate between these disorders as there is some evidence that higher order language performance may be different between these two groups (Murray, 2010). However, it is important to note that there is some evidence for nonliteral language impairment in depression among younger subjects (Brattemo, 1962; Carter, 1986; Iakimova, Passerieux, & Hardy-Baylé, 2006). These studies did not address depression in older populations. We are not aware of any study investigating nonliteral language in geriatric depression. Furthermore, our literature search did not detect any studies comparing nonliteral language difficulties between depression and AD. A less severe impairment of depressed relative to dementia probands is, therefore, still speculative at this time point.

The clinical discrimination between *delirium* and dementia is another challenge in clinical geriatrics. As many bedside tests do not sufficiently discriminate between dementia and delirium, further tests with discriminative power would be helpful. A proverb impairment in delirium would be plausible: in delirium, a frontal–subcortical impairment is commonly observed, so that delirium affects brain networks with a critical role in the comprehension of nonliteral stimuli. Some classical studies demonstrate a proverb impairment in delirium (Campbell & Schubert, 1992; Engel & Romano, 1959), so that proverb comprehension has been suggested as a diagnostic tool in delirium (Engel & Romano, 1959). However, no studies yet compared the discriminative power of nonliteral language tests so far, so research comparing proverb interpretation between delirium and dementia is highly eligible.

Several studies so far addressed impairment in nonliteral language in patients with *traumatic brain injury*, and there is consistent evidence for impairment (Channon, Pellijeff, & Rule, 2005; Davis, 2007; McDonald et al., 2003, 2006). Most studies addressed irony comprehension, which can be impaired for a long period after the trauma (see Martin & McDonald, 2005 for review). Like in delirium and depression, there is a lack of studies comparing the performance with AD patients.

Further studies in AD and geriatric populations are needed. From our perspective, it is not likely that such research will demonstrate *excellent* diagnostic specificity for nonliteral

language, because apart from AD, nonliteral language difficulties have been demonstrated for the important differential diagnoses of Alzheimer's disease mentioned above. On the other hand, it is likely that nonliteral language *could* differentiate between AD and differential diagnoses to some extent. There is good evidence from numerous brain lesion and functional imaging studies that a network including (left) inferior frontal and bilateral lateral temporal gyri plays a key role in the comprehension of nonliteral language (Rapp, 2011). Theoretically, in their early course, dementias with a predominantly fronto-temporal pattern of atrophy should show a greater decline in nonliteral language relative to AD patients, where prefrontal functions often decline in a later stage of the illness. This theoretical assumption is supported by the studies of Moretti and colleagues (e.g., Moretti et al., 2002), in which patients with FTD were more impaired than AD patients in proverb comprehension in the study. However, this effect was less prominent when sarcastic stimuli were used (Rankin et al., 2009). The research by Moretti et al. further indicates that NL language performance is only moderately correlated with the MMSE and clock drawing test. NL language may thus provide adjuvant information to the clinician.

In conclusion, an increasing number of studies address nonliteral language comprehension in AD and related diseases. We identified 25 published studies on nonliteral language, of which many studies have pilot character with low numbers of subjects included. In the face of the ubiquitous usage and decade-long tradition of proverbs in psychiatric assessment, this is an astonishingly low number of studies. Alzheimer patients tend to be impaired for the interpretation of metaphors, proverbs, and idioms. In the limited studies available, they have not been severely impaired for understanding irony. The comprehension of metonymy has not yet been studied. From a research perspective, several important questions mentioned above are addressed insufficiently, so that future research eligible: evidence regarding decline of nonliteral language over the course of the illness is limited. So far, almost no studies delineated proverb comprehension in high risk populations such as patients with mild cognitive impairment and the pattern of impairment especially during the early stages of AD is not yet clear. Currently, there is a lack of studies addressing performance in direct comparison to relevant differential diagnoses like older-age depression, delirium, stroke, traumatic brain injury, or other psychiatric diseases. Notwithstanding these unaddressed questions, we still conclude nonliteral language can represent a worthwhile test tool in everyday clinical routine. The applicability of verbal explanation tasks is good and many clinicians have wide personal experience in nonliteral language testing. An insufficient ability to comprehend nonliteral expressions may indicate a deficit to the clinicians that is not sufficiently detected by other screening tests like the MMSE or clock drawing test. Correct interpretation of nonliteral expressions essentially requires an intact function of a fronto-temporal network and supposedly involves the right cerebral hemisphere in most cases. A perfectly preserved ability to comprehend nonliteral expressions may, therefore, give the clinician an indication that a severe disturbance of the fronto-temporal networks is less likely.

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REFERENCES

Ahrens, K., Liu, H., Lee, C., Gong, S., Fang, S., & Hsu, Y.Y. (2007). Functional MRI of conventional and anomalous metaphors in Mandarin Chinese. *Brain and Language*, *100*, 163–171.

Amanzio, M., Geminiani, G., Leotta, D., & Cappa, S. (2008). Metaphor comprehension in Alzheimer's disease: Novelty matters. *Brain and Language*, *107*, 1–10.

Anaki, D., Faust, M., & Kravetz, S. (1998). Cerebral hemispheric asymmetries in processing lexical metaphors. *Neuropsychologia*, *36*, 691–700.

Andreasen, N.C. (1977). Reliability and validity of proverb interpretation to assess mental status. *Comprehensive Psychiatry*, *18*(5), 465–472.

Annaz, D., Van Herwegen, J., Thomas, M., Fishman, R., Karmiloff-Smith, A., & Rundblad, G. (2009). Comprehension of metaphor and metonymy in children with Williams syndrome. *International Journal of Language & Communication Disorders*, *44*(6), 962–978.

Báez, S., Mendoza, L., Reyes, P., Matallana, D., & Montañés, P. (2009). Interpretación de refranes y enfermedad de Alzheimer. *Revista de Neurologia*, *49*(11), 566–572.

Barth, A., & Küfferle, B. (2001). Die Entwicklung eines Sprichworttestes zur Erfassung konkretistischer Denkstörungen bei schizophrenen Patienten. *Nervenarzt*, *72*, 853–858.

Blasko, D.G., & Kazmerski, V.A. (2006). ERP correlates of individual differences in the comprehension of nonliteral language. *Metaphor and Symbol*, *21*(4), 267–284.

Benjamin, J.D. (1944). A method for distinguishing and evaluating formal thinking disorders in schizophrenia. In J. Kasanin (Ed.), *Language and thought in schizophrenia* (pp. 65–90). Berkeley: University of California Press.

Brattemo, C.E. (1962). Interpretations of proverbs in schizophrenic patients: Further studies. *Acta Psychologica*, *20*(3), 254–263.

Brundage, S.B. (1993). *Comparison of proverb interpretations provided by non-brain-damaged adults, aphasic adults, right-hemisphere-damaged adults, and adults with probable dementia*. Dissertation, University of Minnesota.

Brundage, S.B., & Brookshire, R.H. (1995). A system for scoring proverb interpretations provided by non-brain-damaged adults and aphasic adults. *Clinical Aphasiology*, *23*, 165–177.

Burgess, C., & Chiarello, C. (1996). Neurocognitive mechanisms underlying metaphor comprehension and other figurative language. *Metaphor and Symbolic Activity*, *11*, 67–84.

Burgos, L. (1986). Inter-rater reliability and the use of proverb interpretation in the detection of disordered thinking. *Dissertation Abstracts International*, *46*(7), 2453B.

Campanha, A.C., Lira, J.O., Diniz, A., Ortiz, K.Z., Bertolucci, P.H.F., & Minett, T. (2008). IC-P1-007: Performance comparison of Alzheimer disease and healthy subjects in interpretation of popular proverbs. *Alzheimer's & Dementia*, *4*(Suppl.), T12.

Campbell, K.M., & Schubert, D.S. (1992). Reversal of delirium associated with essential thrombocythemia by antiplatelet therapy. *Psychosomatics*, *33*(2), 213–215.

Carter, M.L. (1986). The assessment of thought deficit in psychotic unipolar depression and chronic paranoid schizophrenia. *The Journal of Nervous and Mental Disease*, *174*(6), 336–341.

Channon, S., Pellijeff, A., & Rule, A. (2005). Social cognition after head injury: Sarcasm and theory of mind. *Brain and Language*, *93*(2), 123–134.

Channon, S., Rule, A., Maudgil, D., Martinos, M., Pellijeff, A., Frankl, J., … Shieff, C. (2007). Interpretation of mentalistic actions and sarcastic remarks: Effects of frontal and posterior lesions on mentalising. *Neuropsychologia*, *45*(8), 1725–1734.

Chapman, S.B., Highley, A.P., & Thompson, J.L. (1998). Discourse in fluent aphasia and Alzheimer's disease: Linguistic and pragmatic considerations. *Journal of Neurolinguistics*, *11*(1–2), 55–78.

Chapman, S.B., Ulatowska, H.K., Franklin, L.R., Shobe, A.E., Thompson, J.L., & McIntire, D.D. (1997). Proverb interpretation in fluent aphasia and Alzheimer's disease: Implications beyond abstract thinking. *Aphasiology*, *11*(4–5), 337–350.

Chen, E., Widick, P., & Chatterjee, A. (2008). Functional-anatomical organization of predicate metaphor processing. *Brain and Language*, *107*, 194–202.

Code, C., & Lodge, B. (1987). Language in dementia of recent referral. *Age and Ageing*, *16*, 366–372.

Colston, H.L., & Gibbs, R.W., Jr. (2002). Are irony and metaphor understood differently? *Metaphor and Symbol*, *17*(1), 57–80.

Cuerva, A.G., Sabe, L., Kuzis, G., Tiberti, C., Dorrego, F., & Starkstein, S.E. (2001). Theory of mind and pragmatic abilities in dementia. *Neuropsychiatry Neuropsychology and Behavioral Neurology*, *14*, 153–158.

Davis, G.A. (2007). Cognitive pragmatics of language disorders in adults. *Seminars in Speech and Language*, *28*(2), 111–121.

Delis, D.C., Kaplan, E., & Kramer, J.H. (2001). *Delis-Kaplan Executive Function System (D-KEFS)*. San Antonio, TX: The Psychological Corporation.

Delis, D.C., Kramer, J., & Kaplan, E. 1984. *The California proverb test*. Unpublished protocol.

Elmore, C.M., & Gorham, D.R. (1957). Measuring the impairment of the abstracting function with the proverbs test. *Journal of Clinical Psychology*, *13*, 263–266.

Engel, G.L., & Romano, J. (1959). Delirium, a syndrome of cerebral insufficiency. *Journal of Chronic Diseases*, *9*, 260–277.

Eviatar, Z., & Just, M.A. (2006). Brain correlates of discourse processing: An fMRI investigation of irony and conventional metaphor comprehension. *Neuropsychologia*, *44*(12), 2348–2359.

Faust, M., & Mashal, N. (2007). The role of the right cerebral hemisphere in processing novel metaphoric expressions taken from poetry: A divided visual field study. *Neuropsychologia*, *45*(4), 860–870.

Farrar, C.B. (1906). The making of psychiatric records. *American Journal of Psychiatry*, *62*, 479–509.

Filippova, E., & Astington, J.W. (2008). Further development in social reasoning revealed in discourse irony understanding. *Child Development*, *79*(1), 126–138.

Finckh, J. (1906). Zur Frage der Intelligenzprüfung. *Zentralblatt für Nervenheilkunde und Psychiatrie*, *29*, 945–957.

Fogel, M.L. (1965). The proverbs test in the appraisal of cerebral disease. *The Journal of General Psychology*, *72*, 269–275.

Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*, 189–198.

Gagnon, L., Goulet, P., Giroux, F., & Joanette, Y. (2003). Processing of metaphoric and non-metaphoric alternative meanings of words after right- and left-hemispheric lesion. *Brain and Language*, *87*, 217–226.

Gibbs, R.W., Jr. (1980). Spilling the beans on understanding and memory for idioms in conversation. *Memory and Cognition*, *8*, 149–156.

Giora, R., Zaidel, E., Soroker, N., Batori, G., & Kasher, A. (2000). Differential effects of right- and left-hemisphere damage on understanding sarcasm and metaphor. *Metaphor and Symbol*, *15*(1&2), 63–83.

Giora, R. (2003). *On our mind: Salience, context, and figurative language*. New York: Oxford University Press.

Giora, R. (2007). Is metaphor special? *Brain and Language*, *100*(2), 111–114.

Glucksberg, S. (2003). The psycholinguistics of metaphor. *Trends in Cognitive Sciences*, *7*(2), 92–96.

Goldstein, R.H., & Salzman, L.F. (1965). Proverb word counts as a measure of overinclusiveness in delusional schizophrenics. *Journal of Abnormal Psychology*, *70*(4), 244–245.

Gorham, D.R. (1956). Use of the proverbs test for differentiating schizophrenics from normals. *Journal of Consulting Psychology*, *20*, 435–440.

Gorham, D.R. (1961). Verbal abstraction in psychiatric illness: Assay of impairment utilizing proverbs. *Journal of Mental Science*, *107*, 52–59.

Hadlich, H. (1931). Schizophrene Denkstörung. *Psychologische Forschung*, *15*, 359–373.

Happé, F.G. (1996). Understanding minds and metaphors: Insights from the study of figurative language in autism. *Metaphor & Symbol*, *10*, 275–295.

Haynes, R.M., Resnick, P.J., Dougherty, K.C., & Althof, S.E. (1993). Proverb familiarity and the mental status examination. *Bulletin of the Menninger Clinic*, *57*(4), 523–528.

Heinik, J., & Aharon-Peretz, J. (1993). Abstract thinking in dementia: A preliminary report. *Clinical Gerontologist*, *12*(4), 57–61.

Hensler, M. (2009). *Sind konkretistische Denkstörungen eine homogene Entität? Untersuchungen zum Verständnis nicht-wörtlicher Sprache bei schizophrenen Patienten*. Thesis, University of Tuebingen, Germany. http://nbn-resolving.de/urn:nbn:de:bsz:21-opus-40670

Hillekamp, U., Knobloch, J., & Buelau, P. (1996). Metaphorische Sprachverarbeitung bei Hirngeschädigten: Anwendung und Analyse eines Metapherntests. *Neurologie & Rehabilitation*, *4*, 232–236.

Hillert, D.G., & Buracas, G.T. (2009). The neural substrates of spoken idiom comprehension. *Language and Cognitive Processes*, *24*(9), 1370–1391.

Horowitz, L.M., & Manelis, L. (1973). Recognition and cued recall of idioms and phrases. *Journal of Experimental Psychology*, *100*, 291–296.

Iakimova, G., Passerieux, C., & Hardy-Baylé, M.C. (2006). The understanding of metaphors in schizophrenia and depression. An experimental approach. *Encephale*, *32*(6 Pt 1), 995–1002.

Jäger, A.O., & Althoff, K. (1983). *WIT: Der Wilde- Intelligenz-Test. Ein Strukturdiagnostikum*. Göttingen: Hogrefe.

Kacinik, N.A., & Chiarello, C. (2007). Understanding metaphoric language: Is the right hemisphere uniquely involved? *Brain and Language*, *100*, 188–207.

Katz, A.N., Blasko, D.G., & Kazmerski, V.A. (2004). Saying what you don't mean: Social influences on sarcastic language processing. *Current Directions in Psychological Science*, *13*(5), 186–189.

Kempler, D., Van Lancker, D., & Read, S. (1988). Proverb and idiom comprehension in Alzheimer disease. *Alzheimer Disease and Associated Disorders*, *2*(1), 38–49.

Kipps, C.M., Nestor, P.J., Acosta-Cabronero, J., Arnold, R., & Hodges, J.R. (2009). Understanding social dysfunction in the behavioural variant of frontotemporal dementia: The role of emotion and sarcasm processing. *Brain*, *132*(Pt 3), 592–603.

Kosmidis, M.H., Aretouli, E., Bozikas, V.P., Giannakou, M., & Ioannidis, P. (2008). Studying social cognition in patients with schizophrenia and patients with frontotemporal dementia: Theory of mind and the perception of sarcasm. *Behavioural Neurology*, *19*(1–2), 65–69.

Lafleche, G., & Albert, M. (1995). Executive functions in mild Alzheimer's disease. *Neuropsychology*, *9*(3), 313–320.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.

Lieberman, P. (1963). Some effects of semantic and grammatic context on the production and perception of speech. *Language and Speech*, *6*, 172–187.

MacKenzie, C., Begg, T., Brady, M., & Lees, K.R. (1997). The effects on verbal communication skills of right hemisphere stroke in middle age. *Aphasiology*, *11*, 929–945.

Martin, I., & McDonald, S. (2005). Exploring the causes of pragmatic language deficits following traumatic brain injury. *Aphasiology*, *19*, 712–730.

Mashal, N., Faust, M., Hendler, T., & Jung-Beeman, M. (2005). The role of the right hemisphere in processing nonsalient metaphorical meanings: Application of principal component analysis to fMRI data. *Neuropsychologia*, *43*, 2084–2100.

McDonald, S., Bornhofen, C., Shum, D., Long, E., Saunders, C., & Neulinger, K. (2006). Reliability and validity of The Awareness of Social Inference Test (TASIT): A clinical test of social perception. *Disability and Rehabilitation*, *28*(24), 1529–1542.

McDonald, S., Flanagan, S., Rollins, J., & Kinch, J. (2003). TASIT: A new clinical tool for assessing social perception after traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *18*, 219–238.

Moretti, M., Torre, P., Antonello, R.M., & Cazzato, G. (2000). Ten-point clock test: A correlation analysis with mini-mental state and proverb interpretation score in Alzheimer's disease. *European Journal of Neurology*, *7*, 746.

Moretti, M., Torre, P., Antonello, R.M., & Cazzato, G. (2001a). Fronto-temporal dementia vs. Alzheimer disease. *Archives of Gerontology and Geriatrics. Supplement*, *7*, 273–278.

Moretti, M., Torre, P., Antonello, R.M., & Cazzato, G. (2001). Is isolated vitamin B12 deficiency a sufficient causative factor of dementia? *European Journal of Neurology*, *8*, 87–88.

Moretti, M., Torre, P., Antonello, R.M., Cazzato, G., & Bava, A. (2002). Ten-point clock test: A correlation analysis with other neuropsychological tests in dementia. *International Journal of Geriatric Psychiatry*, *17*, 347–353.

Moretti, M., Torre, P., Antonello, R.M., Cazzato, G., Bava, A., & Manos, P.J. (2005). Use of the ten-point clock test to compare executive functioning across 24 months in patients with subcortical vascular dementia. *Perceptual and Motor Skills*, *100*, 207–216.

Murray, L.L. (2010). Distinguishing clinical depression from early Alzheimer's disease in elderly people: Can narrative analysis help? *Aphasiology*, Epub 29 January 2010. doi:10.1080/02687030903422460

Nippold, M.A., & Taylor, C.L. (2002). Judgments of idiom familiarity and transparency: A comparison of children and adolescents. *Journal of Speech, Language, and Hearing Research*, *45*(2), 384–391.

Nippold, M.A., & Haq, F.S. (1996). Proverb comprehension in youth: The role of concreteness and familiarity. *Journal of Speech and Hearing Research*, *39*, 166–176.

Novelli, G., Papagno, C., Capitani, E., Laiacona, M., Vallar, G., & Cappa, S.F. (1986). Tre test clinici di ricerca e produzione lessicale: taratura su soggetti normali. *Archivio di Psicologia, Neurologia e Psichiatria*, *47*, 477–505.

Osgood, C.E., & Housain, R. (1974). Salience of the word as a unit in the perception of language. *Perception and Psychophysics*, *15*, 168–192.

Panther, K.U., & Radden, G. (1999). *Metonymy in language and thought*. Amsterdam/Philadelphia: John Benjamins.

Papagno, C. (2001). Comprehension of metaphors and idioms in patients with Alzheimer's disease. A longitudinal study. *Brain*, *124*, 1450–1460.

Papagno, C., & Caporali, A. (2007). Testing idiom comprehension in aphasic patients: The effects of task and idiom type. *Brain and Language*, *100*(2), 208–220.

Papagno, C., Cappa, S.F., Forelli, A., Garavaglia, G., Laiacona, M., Capitani, E., & Vallar, G. (1995). La comprensione non letterale del linguaggio: taratura di un test di comprensione di metafore e di espressioni idiomatiche. *Archivio di Psicologia, Neurologia e Psichiatria*, *56*, 402–420.

Papagno, C., Lucchelli, F., Muggia, S., & Rizzo, S. (2003). Idiom comprehension in Alzheimer's disease: The role of the central executive. *Brain*, *126*, 2419–2430.

Penn, N.E., Jacob, T.C., & Brown, M. (1988). Familiarity with proverbs and performance of a black population on Gorham's Proverbs Test. *Perceptual and Motor Skills*, *66*(3), 847–854.

Qualls, C.D., & Harris, J.L. (2003). Age, working memory, figurative language type, and reading ability: Influencing factors in African American adults' comprehension of figurative language. *American Journal of Speech-Language Pathology*, *12*(1), 92–102.

Rankin, K.P., Salazar, A., Gorno-Tempini, M.L., Sollberger, M., Wilson, S.M., Pavlic, D., … Miller, B.L. (2009). Detecting sarcasm from paralinguistic cues: Anatomic and cognitive correlates in neurodegenerative disease. *Neuroimage*, *47*(4), 2005–2015.

Rapp, A. (2009). The role of the right hemisphere for language in schizophrenia. In I.E. Sommer & R.S. Kahn (Eds.), *Language lateralization in psychosis* (pp. 147–156). Cambridge: Cambridge University Press.

Rapp, A.M. (2011). The brain behind nonliteral language: Insights from brain imaging. In M. Faust (Ed.), *Neuropsychology of language: Advances in the neural substrates of language: Towards a synthesis of basic research and clinical research* (in press). New York: Wiley-Blackwell.

Rapp, A.M., Leube, D.T., Erb, M., Grodd, W., & Kircher, T.T. (2004). Neural correlates of metaphor processing. *Brain Research Cognitive Brain Research*, *20*(3), 395–402.

Rapp, A.M., Leube, D.T., Erb, M., Grodd, W., & Kircher, T.T. (2007). Laterality in metaphor processing: Lack of evidence from functional magnetic resonance imaging for the right hemisphere theory. *Brain and Language*, *100*(2), 142–149.

Rapp, A.M., Markert, K., Erb, M., & Grodd, W. (2010). *Neural correlates of metonymy resolution*. Manuscript submitted for publication.

Rapp, A.M., Mutschler, D.E., Wild, B., Erb, M., Lengsfeld, I., Saur, R., & Grodd, W. (2010). Neural correlates of irony comprehension: The role of schizotypal personality traits. *Brain and Language*, *113*(1), 1–12.

Rapp, A.M., & Schmierer, P. (2010). Proverbs and nonliteral language in schizophrenia: A systematic methodological review of all studies published 1931–2010. *Schizophrenia Research*, *117*(2–3), 422.

Rassiga, C., Lucchelli, F., Crippa, F., & Papagno, C. (2009). Ambiguous idiom comprehension in Alzheimer's disease. *Journal of Clinical and Experimental Neuropsychology*, *31*(4), 402–411.

Reich, J.H. (1981). Proverbs and the modern mental status exam. *Comprehensive Psychiatry*, *22*(5), 528–531.

Rinaldi, M.C., Marangolo, P., & Baldassarri, F. (2004). Metaphor comprehension in right brain-damaged patients with visuo-verbal and verbal material: A dissociation (re)considered. *Cortex*, *40*, 479–490.

Roos, P., & Lewis, J.M. (1962). Differential abstraction deficits in a normal population. *Journal of Nervous and Mental Disease*, *134*(6), 535–538.

Rundblad, G., & Annaz, D. (2010). Development of metaphor and metonymy comprehension: Receptive vocabulary and conceptual knowledge. *British Journal of Developmental Psychology*, *28*(3), 547–563.

Sander, F.M., & Greenberg, H.R. (1968). A proverbial excursion: On the hazards of administering proverbs to test the capacity to abstract. *The Psychiatric Quarterly*, *42*(4), 696–697.

Santos, M.T.F., Carvalho, T.L., Bastos, O., & Sougey, E.B. (2005). Estudo piloto de desempenho mnêmico com "Jogo de Memória de Provérbios" criado para idosos. *Neurobiologia*, *68*(2), 106.

Santos, M.T.F., Guerra, G., Menezes, T.L., Carvalho, T.L., Alchieri, J.C., & Sougey, E.B. (2008). Preliminary data on a mnemonic instrument with proverbs for tracking Alzheimer's disease. *Dementia & Neuropsychologia*, *2*, 333–338.

Santos, M.T.F., Sougey, E.B., & Alchieri, J.C. (2009). Validity and reliability of the Screening Test for Alzheimer's disease with Proverbs (STADP) for the elderly. *Arquivos de Neuro-psiquiatria*, *67*(3-B), 836–842.

Schmidt, G.L., DeBuse, C.J., & Seger, C.A. (2007). Right hemisphere metaphor processing? Characterizing the lateralization of semantic processes. *Brain and Language*, *100*, 127–141.

Schmidt, G.L., Kranjec, A., Cardillo, E.R., & Chatterjee, A. (2010). Beyond laterality: A critical assessment of research on the neural basis of metaphor. *Journal of the International Neuropsychological Society*, *16*(1), 1–5.

Schmidt, G.L., & Seger, C.A. (2009). Neural correlates of metaphor processing: The roles of figurativeness, familiarity and difficulty. *Brain and Cognition*, *71*(3), 375–386.

Shamay-Tsoory, S.G., & Aharon-Peretz, J. (2007). Dissociable prefrontal networks for cognitive and affective theory of mind: A lesion study. *Neuropsychologia*, *45*(13), 3054–3067.

Shamay-Tsoory, S.G., Tomer, R., & Aharon-Peretz, J. (2005). The neuroanatomical basis of understanding sarcasm and its relationship to social cognition. *Neuropsychology*, *19*(3), 288–300.

Shamay-Tsoory, S.G., Tomer, R., & Aharon-Peretz, J. (2002). Deficit in understanding sarcasm in patients with prefrontal lesion is related to impaired empathic ability. *Brain and Cognition*, *48*(2–3), 558–563.

Shibata, M., Abe, J., Terao, A., & Miyamoto, T. (2007). Neural mechanisms involved in the comprehension of metaphoric and literal sentences: An fMRI study. *Brain Research*, *1166*, 92–102.

Shibata, M., Toyomura, A., Itoh, H., & Abe, J. (2010). Neural substrates of irony comprehension: A functional MRI study. *Brain Research*, *1308*, 114–123.

Stringaris, A.K., Medford, N.C., Giampietro, V., Brammer, M.J., & David, A.S. (2007). Deriving meaning: Distinct neural mechanisms for metaphoric, literal, and non-meaningful sentences. *Brain and Language*, *100*(2), 150–162.

Taler, V., & Phillips, N.A. (2008). Language performance in Alzheimer's disease and mild cognitive impairment: A comparative review. *Journal of Clinical and Experimental Neuropsychology*, *30*(5), 501–556.

Thoma, P., & Daum, I. (2006). Neurocognitive mechanisms of figurative language processing – evidence from clinical dysfunctions. *Neuroscience and Biobehavioral Reviews*, *30*(8), 1182–1205.

Thoma, P., Hennecke, M., Mandok, T., Wähner, A., Brüne, M., Juckel, G., & Daum, I. (2009). Proverb comprehension impairments in schizophrenia are related to executive dysfunction. *Psychiatry Research*, *170*(2–3), 132–139.

Treves, T.A., Ragolsky, M., Gelernter, I., & Korczyn, A.D. (1990). Evaluation of a short mental test for the diagnosis of dementia. *Dementia*, *1*, 102–108.

Tseng, W.S., & Streltzer, J. (2008). Cultural aspects of consultation-liaison psychiatry. In H. Leigh & J. Streltzer (Eds.), *Handbook of consultation-liaison psychiatry* (p. 275). Berlin, New York: Springer.

Uekermann, J., Thoma, P., & Daum, I. (2008). Proverb interpretation changes in aging. *Brain and Cognition*, *67*(1), 51–57.

Ulatowska, H.K., Chapman, S.B., Highley, A.P., & Prince, J. (1998). Discourse in healthy old-elderly adults: A longitudinal study. *Aphasiology*, *12*(7–8), 619–633.

Van Lancker, D. (1990). The neurology of proverbs. *Behavioral Neurology*, *3*, 169–187.

Wechsler, D. (1976). *Wechsler Adult Intelligence Scale – Revised*. San Antonio, Texas: Psychological Corporation.

Wegrocki, H.J. (1940). Generalizing ability in schizophrenia; an inquiry into the disorders of problem thinking in schizophrenia. *Archives of Psychology (Columbia University)*, *254*, 76.

Winner, E., & Gardner, H. (1977). The comprehension of metaphor in brain damaged patients. *Brain*, *100*, 717–729.

Winner, E., & Gardner, H. (1993). Metaphor and irony: Two levels of understanding. In A. Ortony (Ed.), *Metaphor and thought* (pp. 425–446). Cambridge: Cambridge University Press.

Yang, F.G., Edens, J., Simpson, C., & Krawczyk, D.C. (2009). Differences in task demands influence the hemispheric lateralization and neural correlates of metaphor. *Brain and Language*, *111*(2), 114–124.

Yang, F.P., Fuller, J., Khodaparst, N., & Krawczyk, D.C. (2010). Figurative language processing after traumatic brain injury in adults: A preliminary study. *Neuropsychologia*, *48*(7), 1923–1929.

Zaidel, E., Kasher, A., Soroker, N., & Batori, G. (2002). Effects of right and left hemisphere damage on performance of the "right hemisphere communication battery". *Brain and Language*, *80*(3), 510–535.