



Are feeling-of-knowing and judgment-of-learning different? Evidence from older adults

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ABSTRACT

This study aims to assess age differences between Judgments-of-learning (JOLs) and Feeling-of-knowing (FOKs) as they are typically studied. The novel contribution of the present study is a comparison between these two metacognitive judgments in a within subject design. Young and older adults were tested on their JOL accuracy and were asked to predict future recall during learning. All participants were also asked to predict future recognition of unrecalled items (FOK judgments). Results showed that although older adults had similar low levels of memory performance in the JOL task and in the FOK task, metacognitive impairments were only found on the resolution of FOKs. Furthermore, an analysis of covariance showed that age differences on memory performance explained the age effect observed on the FOK, thus supporting the *memory constraint hypothesis* (Hertzog et al., 2010). Results are discussed in relation to contemporary models of memory.

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1. Introduction

Metamemory is broadly defined as individual's knowledge of, monitoring of, and control of their own learning and memory processes (Nelson & Narens, 1990). The ability to monitor memory performance has considerable importance in everyday life as it has consequences for subsequent study behavior. This is illustrated in the metamemory framework proposed by Nelson and Narens (1990) by the fact that monitoring (the subjective experience) and control processes (the behavior) operate in a feedback loop: through memory monitoring, we can control our memory function and implement appropriate mnemonic strategies ('*monitoring affects control hypothesis*', Nelson & Leonesio, 1988). As a result, proficient metamemory functioning could lead to more effective memory performance. In other words, accurate metacognitive judgments are essential. If these judgments are wrong, then the control actions (e.g. memory strategies) are likely to be ineffective. In the aging literature, inconsistencies have been found regarding the age effect on metacognitive judgments. For example, while metacognitive judgments made at learning, such as Judgments-of-learning (JOL, Ar buckle & Cuddy, 1969) have been found to be accurate in older adults, judgments made at retrieval such as the Feeling-of-knowing

(FOK, Hart, 1965) seem to be age sensitive. This study aims to assess age differences between JOLs and FOKs as they are typically studied. The novel contribution of the present study is a comparison between these two metacognitive judgments in a within subject design.

1.1. Feeling-of-knowing and Judgment-of-learning

Monitoring of learning has typically been assessed by asking people to make judgments-of-learning (JOLs, Ar buckle & Cuddy, 1969). In a typical JOL experiment, participants are instructed to memorize a list of word pairs and are then asked to rate the likelihood of recalling the second word given the first (cue) word. On the other hand, monitoring of retrieval has been commonly assessed by the Feeling-of-knowing judgment (FOK, Hart, 1965). In this procedure, participants are asked to estimate the likelihood that they will recognize a piece of information they have failed to recall earlier, either from semantic memory (Hart, 1965; Nelson & Narens, 1990), or from episodic memory (Schacter, 1983; Souchay, Isingrini, & Espagnet, 2000). Thus, FOK judgments are predictions about material that participants failed to retrieve while JOLs are prediction about material that participants have yet to retrieve. Metacognitive accuracy is usually measured by correlating the judgments with the memory (recall or recognition) performance, allowing assessment of whether or not the judgments distinguish between what is and what is not remembered (i.e. relative accuracy). Both JOLs and FOKs resolution have been traditionally measured by average intraindividual Goodman–Kruskal gamma

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correlations (Nelson, 1984). Previous experiments on healthy young adults using JOLs have shown that participants are relatively accurate in their predictions (Dunlosky & Connor, 1997; Kelemen, Frost, & Weaver, 2000; Kelemen & Weaver, 1997; Nelson & Dunlosky, 1991; see Rhodes & Tauber, 2011 for a recent meta-analysis). Similar findings have been demonstrated using the FOK paradigm (Kelemen et al., 2000; Schacter, 1983).

The main account proposed to explain JOL accuracy is the two-stage model proposed by Son and Metcalfe (2005). According to this model, JOLs are based either on the familiarity with the cue or on the attempt to retrieve the information. Furthermore, the mnemonic cues used by participants to make their JOLs would depend on the type of JOLs, whether immediate or delayed. Immediate JOLs would be based on encoding fluency, while delayed JOLs would rely on retrieval fluency (Koriat & Ma'ayan, 2005). Like for JOLs, evidence suggests that both the attempt to retrieve the forgotten information and familiarity with cues influence FOKs (Hosey, Peynircioglu, & Rabinovitz, 2009; Koriat, 1993; Metcalfe, Schwartz, & Joaquim, 1993). According to Koriat (1993), FOKs derive from target accessibility, described as the amount of partial information related to the target retrieved while searching for the item. For example, several studies showed that participants successfully retrieve structural-phonological partial information, such as the initial letter (Blake, 1973; Koriat, 1993), or semantic related information, such as the connotative meaning (e.g. Eysenck, 1979; Koriat, 1993; Koriat, Levy-Sadot, Edry, & de Marcas, 2003; Schacter & Worling, 1985; Schwartz, 2002). A more recent development in the FOK literature, suggests that the contextual information associated to the target, such as the source, could be among the information that contributes to guide FOK judgments (Cook, Marsh, & Hicks, 2006). Indeed, recent studies have demonstrated that the retrieval of source information had an influence on the magnitude and the resolution of FOK judgments (Brewer, Marsh, Clark-Foos, & Meeks, 2010; Thomas, Bulevich, & Dubois, 2011). Furthermore, there is evidence supporting the idea that recollection defined as the explicit retrieval of contextual information regarding the encoding episode, may be central to metacognitive judgments such as FOK (Brewer et al., 2010; Hicks & Marsh, 2002; Sacher, Taconnat, Souchay, & Isingrini, 2009; Souchay, Moulin, Clarys, Taconnat, & Isingrini, 2007; Thomas et al., 2011). For example, Hicks and Marsh (2002) showed that high FOK predictions were associated with 'remember' responses in a recognition memory task. Souchay et al. (2007) also demonstrated a relationship between FOK resolution and recollection by showing significant correlations between FOK accuracy scores and Remember responses. In addition, Sacher et al. (2009) found that divided attention – a factor that reduces recollection but leaves familiarity intact (see Yonelinas, 2002) – also affects FOK resolution. Thus, both monitoring at encoding (JOLs) and monitoring at retrieval (FOKs) would rely on the familiarity with the cue. However, while monitoring at encoding (JOLs) would be based on fluency (encoding or retrieval fluency), monitoring at retrieval (FOKs) would rely on other cues such as partial information and recollection (but see Hertzog, Dunlosky, & Sinclair, 2010 for JOLs based on recollection in a task emphasizing the use of recollection).

1.2. Aging

Whether or not metacognitive judgments are age-sensitive has been a core topic of research on metamemory in aging (for review see Hertzog & Hultsch, 2000). A dominant conclusion is that the ability to monitor learning, as measured by JOLs, is spared by aging. Indeed, despite age-related differences in memory performance, JOL resolution is largely age insensitive (for review see Hertzog & Hultsch, 2000; Serra & Dunlosky, 2008, but see Bruce, Coyne, & Botwinick, 1982; Connor, Dunlosky, & Hertzog, 1997). Several studies have also shown that aging has little or no effect on the resolution

of semantic FOKs. The typical finding is that younger and older adults do not differ in their ability to predict which semantic information they will be able to recognize (Allen-Burge & Storandt, 2000; Bäckman & Karlsson, 1985; Butterfield, Nelson, & Peck, 1988; Lachman, Lachman, & Thronesbery, 1979; Marquie & Huet, 2000). However, a number of studies have also found that the resolution of episodic FOKs is impaired in aging (Perrotin, Tournelle, & Isingrini, 2008; Souchay et al., 2000; Souchay et al., 2007; Thomas et al., 2011, but see MacLaverly & Hertzog, 2009). To explain these findings, Souchay et al. (2007) demonstrated that the deficit in episodic FOK resolution in older adults was related to a lack of recollection, as measured by Remember-Know (RK) judgments (Tulving, 1985). A deficit in recollection during recognition test is often reported in older adults (see Yonelinas, 2002) and according to Souchay et al. (2007) older adults would fail to use the contextual information related to the target to make their judgments, resulting in deficits in FOK resolution. Hertzog et al. (2010) recently suggested that the lack of accessible contextual information in older adults might be due to their impoverished memory representation of the items. This *memory constraint hypothesis* predicts that deficient encoding processes will lead to fewer partial or contextual information explaining age differences in episodic FOK (see Perfect & Stollery, 1993 for a similar argument). This hypothesis is supported by studies showing that the retrieval of contextual information improves with deeper encoding processes (Cook et al., 2006) and by the literature showing that FOK resolution improves when the quality of encoding increases (Carroll & Nelson, 1993; Hertzog et al., 2010; Nelson, Leonesio, Shimamura, Landwehr, & Narens, 1982). Thus, our prediction is that in a memory task non-driven by recollection, in which contextual information is not made obvious or participants asked to use any particular strategies at study, JOLs would be based on more automatic age-invariant process (such as encoding or retrieval fluency) while FOKs would depend on more controlled processes sensitive to age (such as recollection).

1.3. The current study

For the first time in the literature, we will explore, using a within design paradigm, the age-related effect on both JOL and FOK resolutions. Based on previous findings, we predict that age will only affect FOK resolution. The *memory constraint hypothesis* (Hertzog et al., 2010) predicts that by equating older and younger adults on their memory performance, and thus potentially on their recollection level, FOK resolution should be equivalent in both groups. We will thus also assess this hypothesis and predict that no age deficits will be observed on the episodic FOK resolution when we control for memory performance using an analysis of covariance. Finally, to further explore the impact of memory performance on both JOLs and FOKs, we will explore any specific relationships between the two metamemory judgments and with the memory performance. We predict here that the two judgments will not correlate with each other (see Kelemen et al., 2000 and Souchay, Isingrini, Clarys, Taconnat, & Eustache, 2004) but also that only FOK accuracy will correlate with memory performance. This should further support the argument according to which memory processes and in particular recollection is crucial for FOKs (Souchay et al., 2007).

2. Method

2.1. Participants

Thirty-six older adults (mean age = 73.58 years, SD = 8.81, Souchay et al., 2004) took part in this study. Sixteen younger adults (mean age = 25.18 years, SD = 3.22) were recruited for this experiment. All participants reported to be in good physical and mental health and free from medication known to affect the central nervous system. All participants in the older sample scored over the cut-off

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