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Improving Medication Understanding and Adherence Using Principles of Memory and Metacognition:

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Abstract

More than half of older adults regularly take multiple medications. Rates of medication non-adherence are high, which undermines both patients' health and the economy. Memory and metacognitive factors (such as misplaced confidence) help explain why patients across the lifespan may not understand or follow prescribed regimens. These factors include difficulties in remembering confusing information; patients' and practitioners' potential overconfidence in memory; and misunderstandings about memory. Patients, practitioners, and the public can use these principles to improve memory, enhance understanding, and promote metacognitive accuracy with respect to complex medication information, which may increase the likelihood of adherence.

Keywords

memory; metacognition; aging; medication; public health

Medication use among older adults is widespread: more than half of people over the age of 65 take five or more medications regularly (Qato et al., 2008). Meanwhile, up to 50% of patients struggle to adhere to their physicians' recommendations, leading to adverse health and economic consequences (Gellad, Grenard, & Marcum, 2011; Hughes, 2004; Roebuck, Liberman, Gemmill-Toyama, & Brennan, 2011). Patients across the lifespan may use medications unwisely (intentionally or not; e.g., DeSantis, Webb, & Noar, 2008). Examining the factors underlying medication nonadherence may help reduce drug interactions among many older adults (Hughes, Cadogan, Patton, & Ryan, 2016; Marcum & Gellad, 2012).

Medication nonadherence is due to many factors, including patients' lack of social and economic support (Goins, Williams, Carter, Spencer, & Solovieva, 2005; Hennessey & Heryer, 2011) and inadequate communication with physicians (Koulayev, Simeonova, & Skipper, 2017). However, before leaving the doctor's office, a potential first way to ensure people adhere to advice is making sure that they understand the information and will remember it – or at least remember where to find it. Remembering medical information is often challenging – similar to learning a new, difficult language (Blake, Hargis, & Castel,

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Tweet: Many do not use medications as advised. Use established principles of memory and self-confidence to boost understanding and adherence.

2016). Common problems include: misremembering specific recommendations (e.g., confusing dosage information for two concurrent medications), having prior knowledge interfere with newer knowledge (e.g., was that a side effect of my old medication or of my new medication?), and being overwhelmed by excess information (e.g., information overload during a doctor's office visit or a pharmacy consultation). As much as 80% of information provided by healthcare practitioners is forgotten immediately (Kessels, 2003).

Further, people are often not aware that they are at risk for forgetting (Castel, McCabe, & Roediger, 2007; Koriat & Bjork, 2005), and many are overconfident about their future memory (Koriat, Bjork, Sheffer, & Bar, 2004; Kornell & Bjork, 2009). Overconfidence in one's memory for medical information could have dire consequences if, for example, one takes an incorrect dosage. Healthcare professionals are also susceptible to metacognitive biases, potentially exhibiting a "curse of knowledge" (Koriat & Bjork, 2005) by expecting patients to remember information with which they themselves are highly familiar.

Many of these challenges can be particularly difficult for older adults to overcome as several cognitive processes decline, even in healthy aging (Hartley et al., 2018; Salthouse, Atkinson, & Berish, 2003). Older adults struggle to remember and adhere to medical recommendations more than younger adults do (Brown & Park, 2002; Morrell, Park, & Poon, 1990; Salzman, 1995), which is especially concerning given older adults' rates of medication use (Qato et al., 2008). To counter these difficulties, patients across the lifespan may benefit from understanding *why* they are taking a given medication and why specific medication instructions matter, rather than simply attempting to abide by the regimen without fully knowing the medications' purpose.

We briefly review factors that influence patients' adherence and understanding. Laboratory-based tasks have examined both memory and metacognition—beliefs about cognition—for medical information. We also provide concrete suggestions to improve patients' understanding and adherence.

The Importance (and Difficulty) of Adhering to a Medication Regimen

Medication nonadherence can occur for a myriad of reasons, including patient-centered factors such as health literacy (Brown & Bussell, 2011), practitioner-centered factors such as a lack of coordinated care (Cutler & Everett, 2010), and system-centered factors such as medication cost (Doshi, Zhu, Lee, Kimmel, & Volpp, 2009; Murray et al., 2004). Failure to adhere to a medication regimen has implications for the patient, of course, but also for society in a broader sense: patient nonadherence to medication regimens costs more than \$100 billion per year in preventable hospitalizations (Cutler & Everett, 2010; Osterberg & Blaschke, 2005). Of those who experience adverse effects due to not taking medication as prescribed, many suffer serious consequences such as falls, low blood pressure, delirium, and heart failure (MacLaughlin et al., 2005). Despite numerous attempts to increase medication adherence rates, few have shown replicable outcomes (Brown & Bussell, 2011; Haynes, Ackloo, Sahota, McDonald, & Yao, 2008; Peterson et al., 2003; but see Gabriel, Gagnon, & Bryan, 1977; Stewart, Murray, Birt, Manatunga, & Darnell, 1993; Park et al., 1992; Wong & Norman, 1987).

Many studies examine medication nonadherence in the elderly, but few focus on the cognitive mechanisms underlying nonadherence (cf. Morrell et al., 1990; Park et al., 1991). Abundant resources allow individuals to learn more about their medications (e.g., websites, pamphlets), and strategies can ensure that important information is not forgotten (e.g., by taking notes during the physician visit), but committing important information to memory—or at least being aware of having forgotten it—can help both patients and practitioners.

Cognitive Factors Affecting Memory for Medical Information

People across the lifespan can face difficulties in remembering medication information for reasons that include memory and metacognitive factors. Some factors, such as the tendency to confuse similar information, particularly challenge older adults, who face greater deficits in inhibiting irrelevant items in memory (May, Hasher, & Kane, 1999; see also Stoltzfus et al., 1993). Given a complex regimen, interference in memory may also occur. That is, medical information that was previously learned may affect memory for current information, such as when a patient's previous knowledge about how and when to take an old medication (no longer taken) disrupts recall of how to take the new medication, leading to memory errors.

Additionally, patients are often told to take a medication at a particular time of the day, or to not take a medication while eating a specific food. Remembering these instructions requires binding the necessary components in memory and, later, being able to recall those associated items. Associating and recalling paired items can be particularly difficult for older adults in a variety of domains (Naveh-Benjamin, 2000; Naveh-Benjamin, Guez, Kilb, & Reedy, 2004; Naveh-Benjamin, Hussain, Guez, & Bar-On, 2003; cf. Hargis & Castel, 2017).

Older adults often rely on gist-based processing (getting the “general picture”) rather than remembering exact, verbatim details (Koutstaal & Schacter, 1997; Tun, Wingfield, Rosen, & Blanchard, 1998). Increased reliance on gist can affect how older people remember specific medical advice, such as exact details about dosage (e.g., 20ml vs 60ml of a liquid cough medication) or which substances to avoid while taking a new medication (e.g., orange juice vs grapefruit juice), which may contribute to dysfunctional doctor-patient interactions.

Metacognitive Factors Affecting Memory for Medical Information

People commonly misconceive how memory works. Metamemory (a type of metacognition) includes beliefs about memory, as well as how people control and monitor their learning (Blake & Castel, 2016). People use metamemory when assessing how likely they are to remember or forget information in the future, as well as when people note whether their memory is generally accurate (or not so accurate) in a given domain.

For example, most people are not aware that processing information deeply will lead to better memory performance later (Bieman-Copland & Charness, 1994; Shaw & Craik, 1989). Additionally, many people believe that once they have learned something, they will remember it far into the future (known as the “stability bias;” Koriat et al., 2004; Kornell & Bjork, 2009). In fact, with time and changes in context (e.g., Radvansky & Copeland, 2006), rapid forgetting of information can occur. People fail to account for this forgetting while

learning, thus committing a metacognitive error. Often studied from an educational perspective, with an eye toward how and when students choose to study information for a later test (e.g., Kornell & Bjork, 2009), the stability bias can also affect metamemory for medical information. If patients feel confident in their memory leaving the doctor's office, this confidence will likely persist, even though some forgetting is highly likely.

Overconfidence in memory can cause individuals to be less likely to restudy information; if they believe they have learned it well initially, they have no reason to try to learn the information again. Large amounts of information about medications are now accessible via the Internet, and this initial "ease of access" can lead to overconfidence that learned information will persist in memory (Kornell, Rhodes, Castel, & Tauber, 2011). Highly confident memory errors among patients may be particularly dangerous when taking medications, as misremembering which medication to take when or which food to avoid may have potentially harmful consequences.

When relaying information to patients, practitioners may exhibit a "curse of knowledge" that leads to suboptimal communication (Birch & Bloom, 2007; Koriat & Bjork, 2005). Medical professionals are experts in their domains, and experts often have difficulty relaying information to a relative novice (although many patients are experienced in taking medications, most have not had a formal medical education). Medical experts may not realize that the clear way in which they believe they have relayed information about a particular medication or diagnosis does not actually make sense to the patient. In failing to account for differences in knowledge and understanding between oneself and others, medical professionals may overestimate how well patients will later remember critical information, representing a metacognitive bias in their communication.

Further, metacognitive factors such as stereotype threat during learning can also sabotage memory. For example, when older adults are asked to complete a task that will test their memory, activating the stereotype that older adults are forgetful can harm their performance (Chasteen, Bhattacharyya, Horhota, Tam, & Hasher, 2005; Hess, Auman, Colcombe, & Rahhal, 2003; Hess, Hinson, & Hodges, 2009). Well-established in the lab (e.g., Chasteen et al., 2005; Mazerolle et al., 2016), stereotype threat might also affect real-life behavior if a patient feels pressure to remember a large amount of information relayed by, perhaps, a younger physician. Clinicians' healthcare decisions may also be affected by their stereotypes about older adults and their beliefs about aging (Davis, Bond, Howard, & Sarkisian, 2011).

Recommendations for Policy, Patients, and Practitioners

As discussed, medication nonadherence across the lifespan is common, significantly impacts health and the economy, and has causes both internal and external to the patient. Memory errors and metacognitive biases by patients and healthcare professionals can lead to misunderstanding and nonadherence. Using established cognitive principles, recommendations involve the patient, the practitioner, and public policy, first in memory, then in metacognition.

Recommendations to Address Memory Factors

When people encounter excessive information, they often struggle to remember it all. However, when some information is deemed important, younger and older adults can remember that important information accurately (Castel, 2008; Castel, Benjamin, Craik, & Watkins, 2002; Castel, McGillivray, & Friedman, 2012; Castel, Middlebrooks, & McGillivray, 2015; Friedman, McGillivray, Murayama, & Castel, 2015; Hargis & Castel, 2017; Middlebrooks, McGillivray, Murayama, & Castel, 2016; cf. Ariel, Price, & Hertzog, 2015). To enable individuals to prioritize, however, the information itself must be structured to show what is valuable. The healthcare provider can simply clarify what is most important to remember (e.g., “this side effect seems small but it’s important to remember, because it is a warning sign for more extensive issues”, as examined in Friedman et al., 2015; see also Heller, Chapman, & Horne, 2017). Then, patients may be in a better position to decide whether some of the information is worth effortfully committing to memory or not. Emphasizing important information (such as dosage instructions) may help, even if those are already written on the medication bottle; the information on those labels is often not well understood or is forgotten (Morrell, Park, & Poon, 1989; Zuccollo & Liddell, 1985).

Knowing what to remember is important, but it can also be helpful to know how to learn information effectively. “Desirable difficulties” (Bjork, 1994) are not often endorsed by participants as being effective for learning, but many such strategies turn out to benefit memory above and beyond “easier” learning strategies. For example, people typically endorse rereading information, or being re-exposed to it in some other way, as the best way to ensure that the information is learned, despite this strategy being fairly ineffective (Yan, Thai, & Bjork, 2014). However, testing, rather than simply rereading, can enhance learning (Larsen et al., 2013; Roediger & Karpicke, 2006). Testing can benefit both memory and metamemory, as the failure to recall information also helps to clarify what one does and does not know.

With respect to medication adherence, “social testing” may be especially useful between a doctor and patient or among friends and partners, with someone asking the patients what information from the visit they are supposed to remember. Indeed, collaboration improves older adults’ memory for medication information (Margrett & Marsiske, 2002; for a review, see Meegan & Berg, 2002). This informal social testing can indicate to the patient and to the other party (e.g., a doctor, friend, or spouse) how well the patient can actually recall the information relative to how well one thinks the information should be recalled.

Generating information can help patients not only remember information and heighten awareness of forgetting (Rawson, O’Neil, & Dunlosky, 2011), it can also benefit patients’ memory for *why* they are taking each medication (e.g., “the white oval-shaped pill treats high cholesterol, and it works by reducing the cholesterol that can build up on my arteries.”). Increasing patient knowledge about medication increases contextual support, which can benefit memory (Cherry & Park, 1993; Smith & Vela, 2001). Also, understanding one’s regimen can increase feelings of self-efficacy and encourage patients to take a more active role in their treatment. That is, if patients understand what a medication treats and how it works, they may be more likely to mention if they notice changes in its effectiveness, or more likely to ask if it can be removed from the regimen if it is no longer providing a clear

benefit. Active engagement by the patient could help ensure that even sophisticated regimens, especially multi-drug regimens, are optimally beneficial (see Reeve & Wiese, 2014).

In a recent Daily Digest email targeted to older adults, the National Institute on Aging (NIA) suggested questions that patients should ask their doctors during checkups (e.g., costs, long-term prognosis, reasons for medications; National Institute on Aging, 2017). The target audience could also learn about empirically-supported memory strategies to use in such situations. Older adults do not tend to apply memory strategies spontaneously (Naveh-Benjamin, Brav, & Levy, 2007, cf. Frank, Jordano, Browne, & Touron, 2016), but can use them effectively when recommended (Dunlosky, Kubat-Silman, & Hertzog, 2003; Paxton, Barch, Storandt, & Braver, 2006). Thus, including memory strategy information and examples of questions to ask *oneself* (rather than just questions to ask one's doctor) could greatly benefit patients' understanding of medication regimens.

Improving memory for medication information could have beneficial outcomes beyond adherence. When older adults perform successfully on a memory task, they carry this success to later tasks (Geraci & Miller, 2013). Perhaps adhering successfully to a complex medication regimen (and, critically, being aware of this success) would increase memory self-efficacy among older adults, which could in turn lead to more effort devoted to subsequent memory tasks, improving performance (Bandura, 1993; Berry & West, 1993). Increasing memory for and understanding of medication information could have far-reaching effects, which in turn may improve adherence.

However, patients do not have to rely solely on their memories for all information that they learn during a healthcare visit. Recently, some have discussed recording doctor's office visits, which physicians both support and oppose (Span, 2017). Setting aside the ethical debates, recording a visit would likely benefit memory if confusing parts could be revisited. If recording is not possible, techniques as simple as paper-based note-taking could greatly increase memory for important information (Kiewra, 1989; King, 1992). Patients should be encouraged to take notes themselves or bring someone who can (Margrett & Marsiske, 2002).

Recommendations to Address Metacognitive Factors

When forgetting is made salient (e.g., in Koriat & Bjork, 2005), people are less likely to believe that memory does not change over time, thereby reducing the stability bias. If patients become less susceptible to the stability bias, they may correctly expect their memory to be less accurate in two weeks than it was at doctor's office (Halamish, McGillivray, & Castel, 2011). Similarly, overconfidence in memory for medication side effects greatly decreases after a brief, laboratory-based memory task (Hargis & Castel, 2017), at least in the short term. Patients who are not overconfident in their memory may be less likely to rely on rote memorization of medical advice, in favor of effective retention strategies such as self-testing.

Communication between practitioner and patient can remedy metacognitive biases and improve adherence (DiDonato & Surprenant, 2015; Hawe & Higgins, 1990; Koulayev et al.,

2017). Presenting experts with a challenging memory task (e.g., Hargis & Castel, 2017) might remind them how it feels to be a novice in learning medication information. The potential influence of memory interference, confusability, and metacognitive biases may become more apparent to physicians given such a task. Ensuring that communication is not impaired by a metacognitive mismatch between what the expert *thinks* the patient knows and what the patient *actually* knows could benefit adherence.

The pharmacist can serve as another line of defense against forgetting and metacognitive biases (Hawe & Higgins, 1990). Assessing memory in a way that avoids inducing stereotype threat (e.g., “I know many people have difficulty taking their medicines, so please tell me how you manage all these drugs”, MacLaughlin et al., 2005, p. 241), highlighting which information is important on a pill bottle, and encouraging the patient to retrieve relevant medication information from memory could all benefit adherence. If pharmacists implement brief techniques such as making patients aware of the stability bias and reviewing potential medication interactions, patients’ memory and metacognition could improve.

Policy Insights and Concluding Comments

Stakeholders including patients, practitioners, and governmental organizations such as the NIA could implement the suggestions proposed above, which are backed by well-established research, with relative ease and at a low cost. Short, simple tests of patients’ memory for their regimens can be done at any point (in fact, repeated testing can be particularly beneficial in remembering medication information; Hargis & Castel, 2018). The benefit of this type of testing is threefold: it shows practitioners what patients do not know, metacognitive biases can be made salient and addressed, and the test itself serves as a learning tool to reinforce patients’ knowledge and understanding.

Continuing education programs for practitioners can incorporate the importance of memory and metacognition at a low cost; demonstrations of memory tasks are quick, potent ways to remedy harmful metacognitive biases. The NIA can incorporate recommendations of effective learning strategies in its healthcare literature by featuring relevant research in a new email (or emails) in the Daily Digest series, and/or by adding brief vignettes or bullet-points to existing electronic or paper-based materials.

Rates of nonadherence to medication regimens are high, especially among older people, many of whom take multiple medications simultaneously. Reducing the number of medications in a patient’s regimen may further boost adherence, especially if some no longer serve a therapeutic purpose (Reeve & Wiese, 2014). Additionally, being aware of and remedying memory and metacognitive errors may alert patients and practitioners that the memory system is an imperfect but important mechanism in adhering to medical advice. Testing memory for important information, communicating more effectively with patients, and incorporating a more accurate perception of one’s memory may benefit understanding of personal medication regimens, increase awareness of possible side effects and dangerous interactions, and improve adherence outcomes for patients across the lifespan.

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Highlights:

- Many people, including older adults, take medications but fail to accurately adhere to prescribed medication regimens, which has detrimental clinical and economic impacts.
- Understanding and remembering medication information can be particularly difficult due to confusability, interference, and stereotype threat, which may in turn impact adherence.
- Mistaken beliefs about their own memories (metacognitive biases) lead people to be overconfident in their ability to remember information (patients) or relay information effectively (healthcare practitioners), but there are ways to lessen these effects.
- Patients, practitioners, and organizations such as the National Institute on Aging can utilize well-established memory and metacognitive principles to construct simple, low-cost methods that improve medication regimen understanding and adherence.