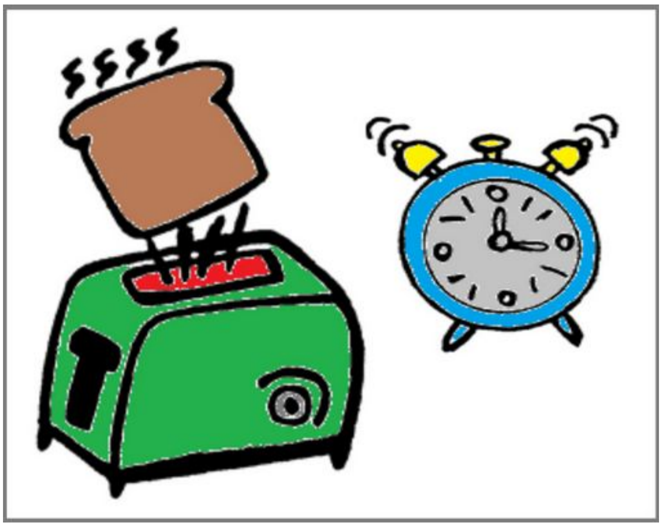
Be ready for your toast! Implicit timing tasks can help understand better how older adults process time

Mariagrazia Capizzi[a], Antonino Visalli[b], Giovanna Mioni[c]
[a] Dept. Psicología Experimental y Centro de Investigación Mente Cerebro y Comportamiento (CIMCYC), Universidad de Granada, España
[b] Dept. Neuroscience, University of Padua, Italy
[c] Dept. General Psychology, University of Padua, Italy

Tipo de artículo: Actualidad, Multilingüe.
Disciplinas: Psicología.
Etiquetas: envejecimiento, decadencia cognitiva, procesamiento temporal.

A common finding in the literature on time perception is that older adults perform poorly on timing tasks as compared to younger adults. However, it is debated whether this reflects a real difficulty of older adults in temporal processing or it is just a consequence of their reduced cognitive functions. A recent study from our lab tested older adults with different ages and cognitive decline on both explicit and implicit timing tasks. Age and cognitive decline had different effects on explicit and implicit timing tasks, suggesting that implicit timing tasks help understand how older adults process time.



(cc) Mariagrazia Capizzi.

Imagine that you volunteer at a seniors' home. This morning you are assisting "uncle Joseph", the way you lovingly call one of the guests, with breakfast. As soon as uncle Joseph puts his toast into the toaster, he turns to you to tell a funny joke. However, as time passes by, uncle Joseph moves his attention back to the toast, just in time to see it popping out from the toaster! In other words, uncle Joseph's temporal expectation about when the toast will be ready "implicitly" grows up with the passage of time.

Now picture a different scenario in which you ask uncle Joseph to report how much time elapsed from the moment he pushed the toaster lever to the moment the toast popped out. Here, time itself

Capizzi, M., Visalli, A., Mioni, G. (2022). Be ready for your toast! Implicit timing tasks can help understand better how older adults process time. *Ciencia Cognitiva*, 16:3, 84-86.

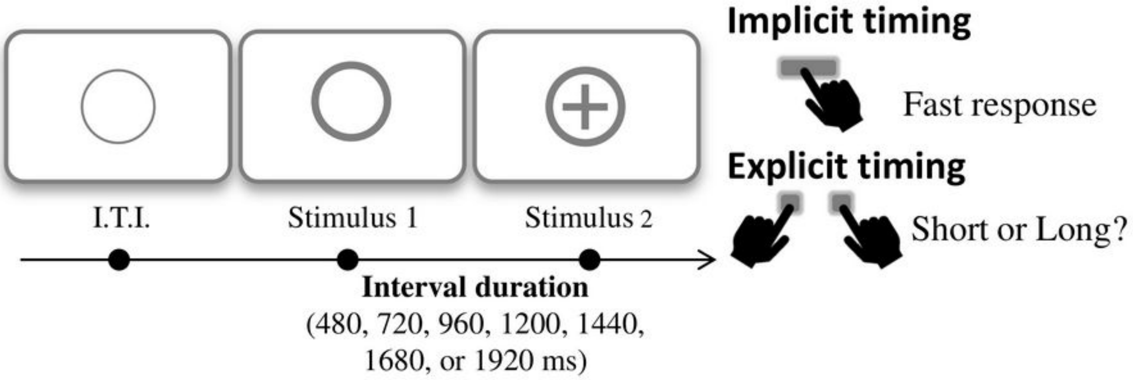


Figure 1. Schematic illustration of the implicit and explicit timing tasks used in Capizzi et al. (2022). Both timing tasks comprised the same stimulus material and general procedure, but differed in the task instructions given to participants. In the implicit timing task, participants had to respond to the cross whenever it appeared inside the thicker circle. In the explicit timing task, participants first memorized the shortest and longest interval durations (i.e., 480 and 1920 ms) separating Stimulus 1 (thicker circle) and Stimulus 2 (cross symbol), and then classified all durations as closer to the "short standard" or to the "long standard". I.T.I. stands for Interval Trial Interval.

becomes the "explicit" focus of the task as uncle Joseph is instructed to process a specific temporal duration. Would uncle Joseph, and in general older adults, behave differently in implicit and explicit timing tasks? And if so, what can we learn about older adults' ability to process time? These questions inspired the work described below.

In the laboratory, the above breakfast scenario can be mimicked using a simple reaction-time task like the one depicted in Figure 1. In this task, a target (the toast in our example, the cross in the figure) is separated from a warning signal (the toaster lever in the example, the thicker circle in the figure) by different interval durations, ranging from shorter (480 ms) to longer ones (1920 ms). At the beginning of each trial the participant does not know whether the target will appear after a shorter or a longer interval. If the target does not occur after a shorter interval, the probability that it will show up grows with the passage of time, exactly as it happens for the toast. This translates into shorter reaction times for targets occurring after longer interval durations, an effect that in the literature is known as the "foreperiod effect" (the term foreperiod refers to the interval between the warning signal and the target). The foreperiod effect is interpreted as evidence for an implicit processing of time. A greater reduction of reaction time as the foreperiod increases shows that the person is becoming more and more prepared to respond, that is, the person is better at predicting when to respond. Given that participants are not instructed to pay attention to time and are uninformed about the interval durations (Coull & Nobre, 2008), this measure of temporal processing is implicit.

In the explicit version of the timing task, participants are first instructed to memorize the shortest and the longest duration displayed in Figure 1 (480 and 1920 ms), called "standard durations", and then to classify all durations as being more similar to the "short" or to the "long" standard. By looking at how participants classify intermediate durations, it is possible to infer valuable information about their underlying temporal processing. To better understand how, let's briefly describe the pacemaker-based models of time (Gibbon, Church, & Meck, 1984). According to such models, temporal judgements depend on the functioning of an "internal clock" described as a pacemaker-plus-counter device. When we estimate a given interval duration, the pacemaker starts emitting pulses that are accumulated in a counter: the greater the number of pulses accumulated, the longer the estimation of the interval duration. It follows that a participant with a faster internal clock will accumulate more pulses and will thus respond more often "long" to intermediate durations, showing an over-estimation bias (scenario 1). By contrast, a participant with a slower clock will accumulate fewer pulses producing more "short" responses to intermediate interval durations (i.e., under-estimation bias; scenario 2). A third scenario is one whereby a participant may respond "short" to some of the longer intermediate durations and "long" to some of the shorter ones, up to the extreme of responding at chance. Such a pattern is not due to a systematic over- or under-estimation bias, but rather to an inability to correctly perform the task probably because of a deficit in understanding or following the instructions, and/or memorizing the standard durations.

The majority of studies investigating temporal abilities in older adults rely on explicit timing tasks. A common finding is that older adults perform poorly as compared to their younger counterparts. The debate on this finding is, however, deadlocked over the question: Is this pattern really due to a dysfunction at the level of temporal processing (i.e., clock functioning as for scenarios 1 and 2), or should it rather be considered a consequence of the decline in general cognitive functions that occurs with age (scenario 3)?

To tackle this question, in our recent study (Capizzi, Visalli, Faralli, & Mioni, 2022), 85 older adults with different ages and level of cognitive decline performed both explicit and implicit timing tasks (Figure 1) in a single session. In the explicit timing task, the older or more compromised participants displayed a pattern in line with a deficit at the level of cognitive functions rather than temporal processing (that is, there were no over- or under-estimation biases but participants often responded "short" to longer intermediate durations and "long" to shorter ones, as in the scenario 3). Conversely, for the implicit timing task, only a decline in cognitive functioning, but not age, was associated with a smaller foreperiod effect, our index of worse time processing. That is, whereas cognitive decline had an impact on both explicit and implicit timing tasks, age spared implicit temporal processing.

These findings suggest that it is cognitive decline, and not age per se, what affects temporal processing. Moreover, they support the idea that observing when Uncle Joseph turns to the toaster to catch the toast in the air is more informative about how he processes time than explicitly asking him how long it took until his toast jumped out (see also Droit-Volet et al., 2019). Possibly, this is because implicit timing tasks pose fewer demands in terms of cognitive control functions (i.e., there are no instructions to pay attention to time or to memorize durations) as compared to explicit timing tasks, where the processing of temporal information might be masked by other cognitive deficits. Much work is underway to explore this possibility.

References

Capizzi, M., Visalli, A., Faralli, A., & Mioni, G. (2022). Explicit and implicit timing in older adults: Dissociable associations with age and cognitive decline. *PLoS ONE,* 17(3): e0264999.

Coull, J. T., & Nobre, A. C. (2008). Dissociating explicit timing from temporal expectation with fMRI. *Current Opinion in Neurobiology*, 18, 137-144.

Droit-Volet, S., Lorandi, F., & Coull, J. T. (2019). Explicit and implicit timing in aging. *Acta Psychologica*, 193, 180-189.

Gibbon, J., Church, R. M., & Meck, W. H. (1984). Scalar timing in memory. *Annals of the New York Academy of Sciences*, 423, 52–77.

Manuscript received on March 22nd, 2022.
Accepted on September 8th, 2022.

This is the English version of
Capizzi, M., Visalli, A., Mioni, G. (2022). ¡Prepárate para tu tostada! Las tareas temporales implícitas nos pueden ayudar a entender mejor cómo las personas mayores procesan el tiempo. *Ciencia Cognitiva*, 16:3, 80-83.