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ORIGINAL RESEARCH

# An Inventory of Problems (IOP) Study of Symptom and Performance Validity in a Sample of Driver's License Renewal or Reinstatement Applicants

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**Abstract**
This study aimed to investigate the specificity of the Inventory of Problems (IOP) tests, specifically the IOP-29 and its memory module (IOP-M), in a high-stakes environment. The study involved 114 Italian adults who applied for the renewal or reinstatement of their driver's license after it had been revoked due to psychiatric, cognitive, or legal issues. The IOP-29 and the IOP-M were administered alongside other tests. Data analysis revealed very few positive results for both the IOP-29 and the IOP-M, indicating high specificity in detecting a possible negative response bias. In fact, the false positive rate (or, more accurately, the *presumably false* positive rate) was less than 5% for each of the two IOP components, meaning that the specificity for the standard cutoff values of each IOP component (i.e., IOP-29 $\geq$ 0.50 and IOP-M $\leq$ 29) was above 0.95. Taken together, these results contribute to the growing body of research supporting the use of the IOP-29 and IOP-M in applied settings where mild cognitive impairment might be present. However, further studies are needed to validate these results in populations with moderate or severe cognitive impairment.

**Keywords** Malingering · Cognitive impairment · IOP-29 · IOP-M · Response bias

Neuropsychological tests typically require that the examinee demonstrate their true ability level (Rai et al., 2023; Sweet et al., 2021). For example, memory tests, typically present the examinee with a series of words, digits, symbols, or other stimuli to encode, and the amount of items correctly recalled is interpreted as an index of their memory skills. For these test scores to provide meaningful results, it is essential that the examinee complies with the test instructions and fully engages with the task(s).

Unfortunately, it is now clear that in real-world evaluations this prerequisite is not always fulfilled, as some individuals may exaggerate their cognitive difficulties, deliberately underperforming on these tasks, in both clinical and forensic settings. Therefore, professionals should incorporate specific measures into their assessment batteries aimed at evaluating the credibility of the presented performance (Sweet et al., 2021). These measures are typically referred to as performance validity tests (PVTs), which can be free-standing, if their sole purpose is to assess the credibility of a given response set, or embedded, if the validity cutoffs are derived from traditional measures of cognitive ability (Boone, 2013).

The most common detection mechanism in PVTs is to present the examinee with a seemingly difficult task that is in fact quite simple (as evidenced by good performance in patients with medically verified neurological disorders associated with significant cognitive impairment). If the observed performance is below an empirically determined cutoff, the presentation is deemed noncredible.

Given the internal logic behind PVTs, an effective way to evaluate their efficacy is to administer them to individuals with genuine cognitive deficits who are motivated to perform their best. Indeed, such a design allows for dissociating the deleterious effects of credible impairment from motivational

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factors. Ideally, PVTs should be calibrated on examinees who not only lack incentive to underperform but are motivated to *perform well* (Abeare et al., 2021; An et al., 2017; Erdal, 2004; Rai et al., 2019). In practice, however, it is difficult to find evaluation settings that satisfy both two criteria (the presence of genuine cognitive deficits and a strong motivation to perform well).

One of the rare situations in which these conditions are likely to be met is the assessment for the reinstatement of driving licenses to individuals who have lost their privilege due to psychiatric, cognitive, or legal problems. In this context, it can be reasonably assumed that most applicants are indeed motivated to demonstrate their higher level of cognitive ability in order to regain their license. Therefore, if a person does not perform well on a PVT in this context, it is unlikely that they are doing so intentionally; instead, it is more likely that their mental health problems are actually affecting their performance. Conversely, a good performance in this context would suggest that in other contexts where the risk of malingering is higher, a low score on the PVT is more likely to be attributable to non-credible responding rather than bona fide neuropsychiatric deficits. In other words, the assessment for the reinstatement of driving licenses provides a unique opportunity to evaluate the false positive rate on a PVT.

## This Study

The primary goal of the present study was to investigate the vulnerability of a recently developed PVT, the Inventory of Problems–memory module (IOP-M; Giromini et al., 2020a, b) to false positive errors in a sample of individuals undergoing neuropsychological evaluation for the renewal or reinstatement of their driving licenses. Given that individuals who seek reinstatement are likely motivated for their application to be successful, it is reasonable to anticipate that, with few unpredictable exceptions, this sample will generally attempt to perform at their maximum ability. If this holds true, any positive results (i.e., scores in the noncredible range) on the IOP-M could reasonably be considered likely *false* positive results.

In Italy, the reasons for requiring a neuropsychological evaluation to obtain a driver's license are diverse, ranging from neuropsychiatric (e.g., schizophrenia) to medical conditions (e.g., cardiovascular disease) to legal reasons (e.g., driving under the influence of alcohol or drugs). In this study, individuals who had committed a criminal traffic offense were evaluated for the reinstatement of their previously revoked driver's license, whereas individuals with different neuropsychiatric and medical conditions were evaluated for the renewal of their driver's license. Thus, one of the aims of our study was to determine the rate of valid performance on the IOP-M among the aforementioned groups in this ecological setting. In addition, considering that different authors have proposed varying IOP-M thresholds for determining performance invalidity (for example, Erdodi et al., 2023 suggested a slightly more liberal cutoff than Giromini et al., 2020a, b), our study also aimed to provide additional information regarding potentially optimal cut scores for the IOP-M. Moreover, given that severe or domain-specific cognitive impairment could increase the likelihood of failures on PVTs (Cutler et al., 2024; Erdodi, 2023; Glassmire et al., 2019; Messa et al., 2022; Tyson et al., 2023), we also sought to analyze the diagnostic accuracy of the IOP-M at different levels of cognitive impairment to generate a reasonable estimate of the false positive rate within the IOP-M.

Because the IOP-M cannot be administered without the Inventory of Problems–29 (IOP-29; Viglione & Giromini, 2020), a short symptom validity test (SVT) aimed at discriminating feigned from authentic symptom presentations, this study also intended to add to the already substantial body of research on the effectiveness of the IOP-29. Despite being introduced only a few years ago, in 2017 (Viglione et al., 2017), there are now more than 30 individual articles supporting its validity, as well as a quantitative literature review (Giromini & Viglione, 2022) and a meta-analytic article (Puente-López et al., 2023a). Taken together, the findings from this rapidly accumulating body of research indicate that the IOP-29 effectively discriminates between genuine/credible and feigned/noncredible presentations related to PTSD, depression, psychosis, and cognitive impairment,

**Table 1** Sociodemographic characteristics of the entire sample

| | *n* | % |
|---|---|---|
| Reasons for requiring neuropsychological evaluation | | |
| Adjustment disorder | 5 | 4.4 |
| Bipolar disorder | 2 | 1.8 |
| Depression/anxiety | 14 | 12.3 |
| Eating disorder | 2 | 1.8 |
| Neuropsychological/intellectual dysfunction | 1 | 0.9 |
| Psychosis/schizophrenia | 6 | 5.3 |
| Specific learning disabilities | 1 | 0.9 |
| Substance use | 31 | 27.2 |
| Other medical conditions | 10 | 8.8 |
| Criminal traffic offenses (including driving under the influence of alcohol or drugs, DUI) | 42 | 36.8 |
| Current psychiatric medication | | |
| Not reported | 1 | 0.9 |
| No | 96 | 84.2 |
| Yes | 17 | 14.9 |
| Past psychiatric medication | | |
| No | 98 | 86.0 |
| Yes | 16 | 14.0 |

**Table 2** Demographic composition of the two MoCA groups

| | Mild cognitive impairment ($n=61$) | Normal range ($n=50$) | Total sample ($N=114$) |
|---|---|---|---|
| Age [$t(109)=-0.22$, $p=.826$, $d=-0.04$] | | | |
| *M* | 36.2 | 36.6 | 35.9 |
| *SD* | 10.4 | 9.5 | 10.3 |
| Education (years) [$t(109)=1.38$, $p=.168$, $d=0.26$] | | | |
| *M* | 11.9 | 11.0 | 11.5 |
| *SD* | 3.6 | 2.7 | 3.2 |
| Gender ($Phi=-.07$, $p=.411$) | | | |
| M | 28 (87.5%) | 64 (81.0%) | 94 (82.5%) |
| F | 4 (12.5%) | 15 (19.0%) | 20 (17.5%) |
| Marital status ($Phi=.08$, $p=.360$) | | | |
| In a relationship | 24 (39.3%) | 24 (48.0%) | 45 (39.5%) |
| Not in a relationship | 37 (60.7%) | 26 (52.0%) | 69 (60.5%) |

The three individuals who did not take the MoCA were included in the total sample but excluded from the analyses on the split sample

achieving a very large Cohen's *d* effect size that exceeds 2.0 (Giromini & Viglione, 2022). However, to our knowledge, only a handful of studies have examined the vulnerability to false positive results of the IOP-29 in applied settings where cognitive impairment may be present, and where evaluees are expected to have no or minimal incentives to overreport the severity of their problems. As such, when we designed our study, we concluded that additional research on this topic would be beneficial to broaden our understanding of the psychometric properties (namely, the specificity) not only of the IOP-M but also of the IOP-29.

## Method

### Participants

The consecutive protocols of 122 Italian adults who had applied for the renewal or reinstatement of their driver's license were considered for this study. Eventually, two participants were excluded because they only completed one of the two IOP components, and four participants were excluded because they had more than 3 missing items at the IOP-M. Finally, because the chief feigning score of the IOP-29 (i.e., the False Disorder probability Score; FDS) is presumed to measure content-related distortion (i.e., negative response bias) as opposed to content-unrelated distortion (e.g., random or fixed responding), two participants were excluded because they presented a high degree of careless responding in their IOP-29s (Random Responding Scale score ≥ 80 T; Giromini et al., 2020a, b; see also Akca et al., 2023; Volarov et al., 2024). Therefore, the final sample consisted of 114 individuals. Among them, 42 participants had their license revoked, 10 participants applied for renewal due to medical conditions, and 62 participants applied for renewal due to psychological reasons. The key sociodemographic characteristics of the final sample are summarized in Tables 1 and 2.

### Measures

#### Inventory of Problems-29 (IOP-29; Viglione & Giromini, 2020)

The Inventory of Problems-29 (IOP-29) is a self-administered SVT comprised of 29 items designed to provide information on the credibility of symptom presentations of various psychiatric and cognitive conditions. Of these 29 items, 27 are multiple-choice questions with three possible response options, i.e., true, false, and doesn't make sense. The remaining two items are performance-based questions presenting the respondent with relatively simple mathematical tasks and open-ended response options. The item content of the IOP-29 is designed to be accessible to readers at the 5th to 6th-grade level, with an estimated Lexile range of approximately 800L to 900L (Viglione & Giromini, 2020).[1]

The key feigning score of the IOP-29, called the false disorder probability score (FDS), is a probability score indicating how similar the protocol is to one of the two IOP-29 reference samples: experimental feigners or genuine patients (Viglione et al., 2017). Higher scores on the FDS indicate a more implausible symptom presentation. According to the IOP-29 manual (Viglione & Giromini, 2020), using FDS cut scores of ≥ 0.15, ≥ 0.30, ≥ 0.50, ≥ 0.65, and ≥ 0.70 should yield specificity values of 30%, 60%, 80%, 90%, and 95%, respectively. These claims are largely supported by a large

[1] The Lexile range was estimated using freely available online Lexile calculators.

body of empirical studies conducted in numerous countries worldwide (e.g., Akca et al., 2023; Blavier et al., 2023; Boskovic et al., 2022; Crișan, 2023; Gegner et al., 2022; Grønnerød et al., 2023; Holcomb et al., 2022; Ilgunaite et al., 2020; Puente-López et al., 2023b; Roma et al., 2020, 2023; Šömen et al., 2021; Winters et al., 2021).

The IOP-29 also includes a measure of random responding, namely the Random Responding Scale (RRS), which was developed by Giromini et al. (2020a, b) to detect careless or random responding. This scale is expressed in T-scores based on the mean and standard deviation of 810 participants included in Giromini et al.'s (2020a, b) development sample. For the current study, we excluded respondents who had a RRS score ≥ 80 T, which resulted in the removal of two participants' data from our analyses, as noted above.

In the current study, the IOP-29 was one of the two target measures under examination. More specifically, we included the IOP-29 to assess its specificity and robustness against false positive results.

#### Inventory of Problems-Memory (IOP-M; Giromini et al., 2020a, b)

The Inventory of Problems-Memory (IOP-M) is a 34-item PVT, which is administered immediately after the IOP-29. Test takers are presented with a list of pairs of words or sentences and their task is to identify, for each item, the one word or sentence that was presented before in the IOP-29. The strategy adopted in the IOP-M is known as the "floor effect" strategy, which relies on the idea that feigners may perform worse than impaired patients, as they may not be able to recognize the simplicity of the task proposed (Rogers, 2018). The IOP-M raw cutoff score is a number of correct responses equal to or lower than 29, while more conservative cut score ranges between ≤ 28 and ≤ 27. Giromini et al. (2020a, b) reported a specificity value approximating or exceeding 90% for all the previous cutoffs when considering the honest respondents included in their study.

In the current study, the IOP-M was the primary measure under examination.

#### Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005)

The MoCA is a widely used neuropsychological performance, screening test designed to assess possible cognitive impairment. It evaluates various areas such as short-term memory, visuospatial abilities, executive functions, attention, concentration, working memory, language, and orientation to time and place. The MoCA has already been established as a useful screening tool in assessing driver performance in older adults (Kandasamy et al., 2019; Lee et al., 2018; Tinella et al., 2020), individuals with dementia (Ma'u & Cheung, 2020), and glaucoma (Gangeddula et al., 2017). Scores on the MoCA range from 0 to 30. To interpret the MoCA scores (i.e., both normal and age education adjusted scores), the following characterization is typically used: scores below 10 were categorized as "severe cognitive impairment," scores between 10 and 17 as "moderate cognitive impairment," scores between 17 and 25 as "mild cognitive impairment (MCI)," and higher than 25 as "normal range."[2] Additionally, the MoCA includes "adjusted scores" to control for the effect of age and education.

In the current study, the MoCA was used to quantify the cognitive impairment of our participants.

#### Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1977, 1994)

The SCL-90-R is a 90-item, self-report questionnaire used to assess nine dimensions of psychopathology: somatization (SOM), obsessive–compulsive (O-C), interpersonal sensitivity (I-S), depression (DEP), anxiety (ANX), hostility (HOS), phobic anxiety (PHOB), paranoid ideation (PAR), and psychoticism (PS). Each item is rated on a 5-point Likert scale from 0 (Not at all) to 4 (Extremely), reflecting the severity of symptoms and manifestations of distress experienced during the last week. It contains also three global indices: the Global Severity Index (GSI), a measure of overall psychological distress, the Positive Symptom Distress Index (PSDI), a measure of the intensity of the reported symptoms, and the Positive Symptom Total (PST), which computes the number of reported symptoms.

In the current study, we used the SCL-90-R to assess the psychological distress levels of our participants. Specifically, its primary function was to measure the general level of psychopathology in our sample, enabling us to determine the generalizability of our findings.

#### DRIVESC Fitness to Drive Screening Test (DRIVESC; Schuhfried, 2016)

The DRIVESC Fitness to Drive Screening Test is part of the Vienna Test System (Schuhfried, 2016) and assesses several abilities and dimensions relevant to predict the level of fitness to drive. It evaluates reaction and motor speed (Reaction Test), resilience of attention (Determination Test), and perception speed (Adaptive Tachistoscopic

[2] The categorization of severity levels for the MoCA was sourced from the official MoCA website (https://www.mocatest.org/faq/). However, as the research substantiating these severity ranges is still in progress, these classifications should be viewed as provisional.

Traffic Perception Test). Several studies have demonstrated the predictive validity of the DRIVESC test set for both real-world and simulated driving performance (Schuhfried, 1998; Vetter & Debelak, 2012). The device consisted of an LCD computer monitor, a standard audio output device (headset), an ergonomic response panel, and two-foot pedals.

Similar to the SCL-90-R, the inclusion of DRIVESC scores in our analyses aimed to precisely characterize our sample and better understand the populations to which our study results may generalize.

### Procedure

The research project has been evaluated and approved by the local Ethical Committee. The participants in the study were Italian adults whose driver's licenses were under review for reinstatement or renewal. Participants whose licenses had been revoked for traffic offenses sought reinstatement of their licenses, while participants with psychiatric or medical conditions that could impair their driving ability applied for the renewal of their licenses. All participants were evaluated with the same test battery described in the "Measures" section with the exception of three participants who did not take the MoCA. All tests were administered in the same order to every participant, and each participant completed the test battery in a single session.

### Statistical Analyses

To assess the diagnostic accuracy of the IOP at different levels of cognitive impairment, we divided the sample into two groups based on the MoCA cut scores mentioned above: individuals who scored between 17 and 25 on the MoCA were categorized as having "mild cognitive impairment" ($n = 61$), while those who scored $\geq 26$ (the recommended cut-off for intact abilities) were categorized as in the "normal range" ($n = 50$). The three participants who did not take the MoCA were included in the overall analysis, but they were not assigned to either group. Before conducting any analysis, we compared sociodemographic variables, the SCL-90-R, and DRIVESC scores between the two MoCA groups to identify potential differences that might influence our results. Then, we compared the IOP-29 and IOP-M scores between the two groups and calculated the specificity values to test different cut-scores. Finally, we compared the MoCA, SCL-90-R, DRIVESC, IOP-29, and IOP-M scores between three groups based on the reasons for assessment: participants who had their license revoked, participants who applied for renewal due to medical conditions, and participants who applied for renewal due to psychological conditions.

## Results

In this sample ($N = 114$), the MoCA Total score ranged from 21 to 30 with a mean value of 26.5 ($SD = 2.1$). Using the aforementioned cut scores, 61 individuals were classified as possibly affected by "mild cognitive impairment," while 50 were classified as having intact cognitive abilities. As shown in Table 2, these two groups did not differ from each other in terms of age, gender, education, and marital status. In addition, the two groups did not differ in levels of symptoms and/or distress as measured by the SCL-90-R, nor did they differ in their performance on the DRIVESC Fitness to Drive Screening Test (Table 3).

The descriptive statistics of the IOP-29 and IOP-M scores of both groups are shown in Table 4. Although both the IOP-29 FDS and RRS scores did not differ between the two groups, the IOP-M scores showed a statistically significant lower mean score in the "mild cognitive impairment" group ($t = -2.59$; $p = 0.010$); however, the effect size was at the upper end of the small range ($d = -0.46$). Lastly, we computed specificity values for the recommended cut scores of the IOP-29 and IOP-M for the two groups (Table 5). As shown in Table 5, specificity values did not differ between groups, with the sole exception of the most conservative IOP-M cut score of $\leq 30$ ($Phi = -0.23$, $p = 0.013$). Nevertheless, the specificity values for both tests were high, with values of more than 95% for the standard cutoff values of both the IOP components, i.e., IOP-29 FDS $\geq 0.50$ and IOP-M # of correct answers $\leq 29$.

Finally, we compared the scores between the three groups based on the reasons for assessment: participants who had their license revoked ($n = 42$), participants who applied for renewal due to medical conditions ($n = 10$), and participants who applied for renewal due to psychological conditions ($n = 62$). The three groups did not differ in terms of cognitive impairment (MoCA Total Score: $F_{(2, 108)} = 0.78$, $p = 0.460$, $\eta^2 = 0.014$), levels of symptoms and/or distress (SCL-90-R: $F_{(2, 111)} < 1.69$, $p > 0.189$, $\eta^2 < 0.030$), or abilities associated with the fitness to drive (DRIVESC: $F_{(2, 111)} = 0.21$, $p = 0.809$, $\eta^2 = 0.004$). Moreover, the three groups produced similar scores on both the IOP-29 ($F_{(2, 111)} = 1.37$, $p = 0.257$, $\eta^2 = 0.024$) and the IOP-M ($F_{(2, 111)} = 1.00$, $p = 0.369$, $\eta^2 = 0.018$).

## Discussion

The aim of this study was to investigate the specificity of the Inventory of Problems (IOP) tests, i.e., the IOP-29 and its Memory module (IOP-M), in a high-stakes environment where participants were presumably motivated to perform at

**Table 3** Mean differences in the SCL-90-R and DRIVESC Scores between the two MoCA groups

| | Mild cognitive impairment ($n=61$) | | Normal range ($n=50$) | | $t$ | $df$ | $p$ | $d$ |
|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | | | | |
| SCL-90-R somatization (SOM) | 42.8 | 5.9 | 42.4 | 7.8 | 0.29 | 109 | .767 | 0.05 |
| SCL-90-R obsessive–compulsive (O-C) | 42.6 | 5.8 | 42.8 | 5.9 | −0.14 | 109 | .885 | −0.02 |
| SCL-90-R interpersonal sensitivity (I-S) | 43.7 | 6.1 | 43.0 | 6.1 | 0.56 | 109 | .574 | 0.10 |
| SCL-90-R depression (DEP) | 43.0 | 5.3 | 43.4 | 7.0 | −0.37 | 109 | .711 | −0.07 |
| SCL-90-R anxiety (ANX) | 43.6 | 5.4 | 45.0 | 7.0 | −1.13 | 109 | .258 | −0.21 |
| SCL-90-R hostility (HOS) | 41.9 | 4.4 | 43.0 | 6.7 | −0.96 | 81.4 | .337 | −0.19 |
| SCL-90-R phobic anxiety (PHOB) | 45.4 | 3.5 | 45.6 | 3.0 | −0.40 | 109 | .687 | −0.07 |
| SCL-90-R paranoid ideation (PAR) | 44.3 | 7.8 | 44.8 | 8.5 | −0.31 | 109 | .755 | −0.06 |
| SCL-90-R psychoticism (PSY) | 44.1 | 5.0 | 45.5 | 6.8 | −1.18 | 87.7 | .238 | −0.23 |
| SCL-90-R Global Severity Index (GSI) | 42.2 | 5.6 | 42.5 | 7.0 | −0.29 | 108 | .767 | −0.05 |
| SCL-90-R Positive Symptom Distress Index (PST) | 40.8 | 7.8 | 41.6 | 9.1 | −0.49 | 108 | .619 | −0.09 |
| SCL-90-R Positive Symptom Total (PSDI) | 43.7 | 6.1 | 43.6 | 6.6 | 0.07 | 108 | .939 | 0.01 |
| DRIVESC total QD | 106.5 | 6.9 | 107.6 | 5.1 | −0.92 | 109 | .359 | −0.17 |

Mild cognitive impairment refers to MoCA scores between 17 and 25; normal range refers to MoCA scores higher than 25. The three individuals who did not take the MoCA were included in the total sample but excluded from the analyses on the split sample

**Table 4** Mean differences in the IOP-29 and IOP-M scores between the two MoCA groups

| | Mild cognitive impairment ($n=61$) | | | | Normal range ($n=50$) | | | | $t$ | $df$ | $p$ | $d$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Min* | *Max* | *M* | *SD* | *Min* | *Max* | *M* | *SD* | | | | |
| IOP-29 FDS | 0.01 | 0.67 | 0.17 | 0.15 | 0.01 | 0.67 | 0.17 | 0.12 | 0.11 | 109 | .911 | 0.02 |
| IOP-29 RRS | 39.0 | 75.0 | 56.6 | 7.4 | 41.9 | 77.6 | 54.9 | 7.8 | 1.17 | 109 | .244 | 0.22 |
| IOP-M # of correct answers | 21 | 34 | 32.7 | 2.1 | 31 | 34 | 33.5 | 0.8 | −2.59 | 80.1 | .010 | −0.46 |

Mild cognitive impairment refers to MoCA scores between 17 and 25; normal range refers to MoCA scores higher than 25. The three individuals who did not take the MoCA were included in the total sample but excluded from the analyses on the split sample. Because homoscedasticity could not be assumed for the IOP-M, the Welch-Satterthwaite method was employed to adjust the degrees of freedom to account for the inequality of variances

their best. The primary takeaway from our statistical analyses is that both the IOP-29 and IOP-M yielded exceptionally few positive results. This suggests that these two measures are likely to provide excellent specificity when assessing the potential presence of a negative response bias. In fact, the specificity for the standard cutoff values of each IOP component (i.e., IOP-29 FDS $\geq 0.50$ and IOP-M correct responses $\leq 29$) exceeded 0.95. Taken together, these findings thus confirm the robustness of these instruments to genuine neuropsychiatric impairments and thus, false positive errors, in real-world assessment settings.

As for the IOP-M, which was the primary target of the current investigation, our results largely align with existing research findings. Prior to our study, numerous simulation studies (Banovic et al., 2022; Blavier et al., 2023; Bosi et al., 2022; Carvalho et al., 2021; Crișan, 2023; Gegner et al., 2022; Giromini et al., 2020a, b; Puente-López et al., 2023b; Šömen et al., 2021) and a couple of criterion-group studies (Erdodi et al., 2023; Holcomb et al., 2022) confirmed that the IOP-M cutoff value of $\leq 29$ yields a specificity value greater than 90%. In addition, some authors (e.g., Erdodi et al., 2023) suggested that a more liberal cutoff score of $\leq 30$ might already reach that level of specificity. However, few of those studies included cognitively impaired respondents, and none presented an ecologically valid, high-stakes context where respondents would likely be motivated to present themselves positively (i.e., more cognitively healthy), rather than negatively (i.e., more cognitively impaired).

**Table 5** Specificity values for the IOP-29 FDS and IOP-M # of correct answers in the total sample and the two MoCA groups

| | Total sample ($N=114$) | | Mild cognitive impairment ($n=61$) | | Normal range ($n=50$) | | *Phi* | *p* |
|---|---|---|---|---|---|---|---|---|
| | *N* | % | *N* | % | *N* | % | | |
| IOP-29 false disorder score (FDS) | | | | | | | | |
| < .15 | 71 | **62.3** | 38 | **62.3** | 30 | **60.0** | .02 | .805 |
| ≥ .15 | 43 | 37.7 | 23 | 37.7 | 20 | 40.0 | | |
| < .30 | 97 | **85.1** | 50 | **82.0** | 44 | **88.0** | -.08 | .380 |
| ≥ .30 | 17 | 14.9 | 11 | 18.0 | 6 | 12.0 | | |
| < .50 | 110 | **96.5** | 58 | **95.1** | 49 | **98.0** | -.07 | .412 |
| ≥ .50 | 4 | 3.5 | 3 | 4.9 | 1 | 2.0 | | |
| < .65 | 111 | **97.4** | 59 | **96.7** | 49 | **98.0** | -.09 | .679 |
| ≥ .65 | 3 | 2.6 | 2 | 3.3 | 1 | 2.0 | | |
| < .70 | 114 | **100.0** | 61 | **100.0** | 50 | **100.0** | - | - |
| ≥ .70 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | | |
| IOP-M # of correct answer | | | | | | | | |
| > 30 | 107 | **93.9** | 54 | **88.5** | 50 | **100.0** | -.23 | .013 |
| ≤ 30 | 7 | 6.1 | 7 | 11.5 | 0 | 0.0 | | |
| > 29 | 111 | **97.4** | 58 | **95.1** | 50 | **100.0** | -.15 | .112 |
| ≤ 29 | 3 | 2.6 | 3 | 4.9 | 0 | 0.0 | | |
| > 28 | 112 | **98.2** | 59 | **96.7** | 50 | **100.0** | -.12 | .196 |
| ≤ 28 | 2 | 1.8 | 2 | 3.3 | 0 | 0.0 | | |
| > 27 | 113 | **99.1** | 60 | **98.4** | 50 | **100.0** | -.08 | .363 |
| ≤ 27 | 1 | 0.9 | 1 | 1.6 | 0 | 0.0 | | |

Specificity values are bolded. Mild cognitive impairment refers to MoCA scores between 17 and 25; normal range refers to MoCA scores higher than 25. The three individuals who did not take the MoCA were included in the total sample but excluded from the analyses on the split sample

From this perspective, our study adds to the existing literature by providing an ecologically valid setting in which negative response distortion was unlikely to occur. And based on our results, the best cutoff value for the IOP-M, that is, the one that ensures a specificity of at least 0.90 (Sherman et al., 2020; Sweet et al., 2021), is ≤ 29. In fact, when using ≤ 29, the percentage of (presumably false) positive results was less than 5% in both the "normal range" (i.e., specificity = 1.00) and the "mild cognitive impairment" (i.e., specificity = 0.95) groups. Conversely, when using the more liberal cutoff score of ≤ 30, the percentage of (presumably false) positive results rose to 11.5% (i.e., specificity = 0.885) in the "mild cognitive impairment" group, although it remained zero in the "normal range" group (i.e., specificity = 1.00). Thus, pending additional research on this topic, our recommendation is to continue considering IOP-M ≤ 29 as the optimal cutoff value for applied settings.

Regarding the IOP-29, there is currently some debate about the appropriate cutoff value to use in high-stakes forensic contexts. When the IOP-29 professional manual was first released, Viglione and Giromini (2020) cautiously suggested that the standard cutoff for the IOP-29, i.e., FDS ≥ 0.50, would likely yield specificity and sensitivity values of approximately 0.80. Therefore, they proposed that using an IOP-29 cutoff of FDS ≥ 0.65 might be preferable in high-stakes forensic evaluations to achieve a specificity of about 0.90, despite a lower sensitivity of about 0.60. However, subsequent research suggested that the standard IOP-29 cutoff of FDS ≥ 0.50 might already be effective enough to meet the specificity ≥ 0.90 standard without the need to use the more conservative cutoff of FDS ≥ 0.65. Indeed, a quantitative literature review published in 2022 (Giromini & Viglione, 2022) found that the IOP-29 cutoff of FDS ≥ 0.50 yielded a weighted mean specificity of 0.92 (weighted SD = 0.06), and a bivariate diagnostic test accuracy meta-analytic study published one year later (Puente-López et al., 2023a) reported a highly similar average specificity value of 0.93 for that same cutoff.

Consistent with these recently published quantitative review and meta-analytic research articles, the current study found that the standard cutoff of the IOP-29, i.e., FDS ≥ 0.50, yielded specificity values of 0.98 and 0.95 respectively when considering the "normal range" and "mild cognitive impairment" groups. This implies that the percentage of (presumably false) positive results was lower than 5% in either group. Accordingly, when assessing evaluees who are not presenting with particularly severe cognitive or psychiatric problems, we concur with those authors (e.g., Holcomb et al., 2022) who claim that it is highly likely that the standard IOP-29 cutoff of FDS ≥ 0.50 will already offer a specificity

of at least 0.90 with no need to raise the cutoff to FDS ≥ 0.65. Notably, none of the evaluees in our study had an IOP-29 FDS score exceeding 0.70. Although there is no such thing as a "below-chance" result in the SVT arena (Giromini & Erdodi, 2023), pending future replications, this finding seems to suggest that an IOP-29 FDS value higher than 0.70 is so rare that it might be considered psychometrically equivalent to a below-chance result on a PVT.

Despite the encouraging results outlined above, our study does have some limitations that should be noted. First, although the sample size is similar to that of most published studies focusing on symptom and performance validity (Pignolo et al., 2023; Rogers et al., 2003), it is relatively small and limited to a specific group of Italian adults seeking to renew or regain their previously revoked driver's license. This may limit the generalizability of the results to other settings and/or other racial/ethnic populations. In addition, the study relied on self-report measures and a single cognitive screening tool (MoCA), which, while widely used, may not capture all aspects of cognitive impairment. Moreover, a study based on samples recruited from southern Italy (Bosco et al., 2017) found discrepancy in cut-off points existing between Italian and other international validation studies, possibly due to different levels of literacy and cross-cultural factors. And applying Bosco et al.'s (2017) findings to the current study suggests a potential slight overestimation of cognitive impairment in our sample, implying that the two groups (i.e., mild cognitive impairment versus normal range) may be more similar to each other than the observed MoCA scores suggest. For this reason, and given the lack of severely cognitively impaired patients in our study, the generalizability of our findings to samples with confirmed cognitive impairment is questionable.

Perhaps more importantly, none of our participants appeared to have severe cognitive impairment, limiting the generalizability of our study's findings to only those patient populations with mild or no cognitive impairment. Furthermore, although most participants likely had no reason to underperform or overreport, our design alone does not rule out non-credible performance, as there is no guarantee that none had reason to perform poorly. Additionally, factors such as poor engagement or lack of motivation can also contribute to PVT failures. Ideally, future replications should incorporate other PVTs and SVTs to confirm the validity status of examined presentations. Despite all these limitations, our study still has the merit of being the first to present the results of the IOP combination, i.e., IOP-29 and IOP-M, in an ecologically valid sample of individuals with and without cognitive impairment, where negative response bias was unlikely to be a confounding factor.

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## Declarations

**Conflict of Interest** Luciano Giromini is a member of the LLC that owns the rights to the Inventory of Problems-29 (IOP-29).

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