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What are the factors that contribute to road accidents? An assessment of law enforcement views, ordinary drivers' opinions, and road accident records

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ABSTRACT

What are the main contributing factors to road accidents? Factors such as inexperience, lack of skill, and risk-taking behaviors have been associated with the collisions of young drivers. In contrast, visual, cognitive, and mobility impairment have been associated with the collisions of older drivers. We investigated the main causes of road accidents by drawing on multiple sources: expert views of police officers, lay views of the driving public, and official road accident records. In Studies 1 and 2, police officers and the public were asked about the typical causes of road traffic collisions using hypothetical accident scenarios. In Study 3, we investigated whether the views of police officers and the public about accident causation influence their recall accuracy for factors reported to contribute to hypothetical road accidents. The results show that both expert views of police officers and lay views of the driving public closely approximated the typical factors associated with the collisions of young and older drivers, as determined from official accident records. The results also reveal potential under-reporting of factors in existing accident records, identifying possible inadequacies in law enforcement practices for investigating driver distraction, drug and alcohol impairment, and uncorrected or defective eyesight. Our investigation also highlights a need for accident report forms to be continuously reviewed and updated to ensure that contributing factor lists reflect the full range of factors that contribute to road accidents. Finally, the views held by police officers and the public on accident causation influenced their memory recall of factors involved in hypothetical scenarios. These findings indicate that delay in completing accident report forms should be minimised, possibly by use of mobile reporting devices at the accident scene.

1. Introduction

Motor vehicle collisions cause more than 1.2 million deaths worldwide and an even greater number of non-fatal injuries each year (World Health Organization, 2015), negatively affecting the health and wellbeing of injury survivors and their families (Donaldson et al., 2009). To improve road safety, insight is needed into preventable causes of road accidents. Police reports of road accidents are the main source of data used for informing research and policy on the causes of road accidents. Concerns have been raised by academics and road safety authorities over the reliability of police-reported contributing factor data (DfT, 2014a), but there has been little or no attempt to investigate this issue empirically. This article aims to contribute to filling this gap by investigating the main causes of road accidents reported in accident records and comparing them with expert views of police officers and lay views of the driving public.

The causes of motor vehicle collisions are complex, but broadly depend on characteristics of drivers. Skill level (McGwin & Brown, 1999), inexperience (McCartt et al., 2003), and risk taking behaviors (Rolison et al., 2014) have been implicated in the collisions of young drivers compared to drivers in other age ranges. Investigations of vehicle collision records have also implicated excessive speed (Gonzales et al., 2005; Lam, 2003), driving recklessly (Lam, 2003), and traffic violations (Gonzales et al., 2005) as well as drugs and alcohol (Bingham et al., 2008) in the collisions of young drivers. For example, Braitman et al. (2008) interviewed 16-year-old novice drivers who had been involved in a collision within eight months of receiving their driver license. Excessive speed, loss of control, and failure to detect another vehicle or traffic control were reported by the teenagers as primary causes of their collisions (Braitman et al., 2008). Collectively, these findings support the role of inexperience, lack of skill, and risk taking behaviors in young driver collisions. Further, these contributing factors

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appear to be influenced by driver gender. Young male drivers are more likely than young females to be involved in collisions due to risk taking, such as excessive speeding and impairment by drugs and alcohol (Begg & Langley, 2004; Clarke et al., 2006; Curry et al., 2012).

In contrast with young drivers, the collisions of older drivers more often involve driver error at intersections and when making turns (Hakamies-Blomqvist, 1993; Langford & Koppel, 2006). McGwin and Brown (1999) found that failure to yield right of way, failure to comply with signs and signals, failure to see objects, and improper turns and lane changes were commonly reported in road accident records for collisions of older drivers. Older driver errors may in part result from age-related decline in visual, cognitive, and mobility functioning in older age (Hu et al., 1993; Janke, 1991). A wealth of research has identified poor performance on measures of visual functioning and cognitive abilities as risk factors for older driver involvement in road traffic collisions (Ball et al., 2010; Ball et al., 2006; Owsley et al., 1991; Owsley et al., 1998). Medical conditions, such as heart disease and stroke, are further associated with increased risk of collision among older drivers (McGwin et al., 2000; Anstey et al., 2005). Finally, psychoactive medications, commonly used by older drivers, can hamper their driving ability, and place them at increased risk of crash involvement (Hemmelgarn et al., 1997; Meuleners et al., 2011; Ray et al., 1992).

In sum, inexperience and risk taking behaviors, including excessive speed and drug and alcohol use, have been associated with the collisions of young drivers. Conversely, as age advances, increased prevalence of visual and cognitive impairments as well as medication use have been associated with the collisions of older drivers.

The majority of research investigating the contributing factors of road accidents involving young and older drivers has used accident data from police reports. In the United Kingdom, police officers attending road accident scenes are required to provide a subjective assessment of the factors that they believe contributed to the collision. Thus, police officers who have first-hand experience reporting on road accidents are likely to possess valuable insight into the causes of accidents involving young and older drivers. Their views are likely to be more accurate than the views of the driving public, which should be more reliant on stereotypic perceptions of young and older drivers. In fact, the views of police officers about some accident causes may be more accurate than official reports based on road accident records. This is because some factors are difficult to verify or substantiate at the roadside and thus may be underreported in accident records. For example, driver distraction due to mobile phone use can be difficult to verify, leading to underreporting in accident records (NHTSA, 2009). In 2008, reports of driver distraction in fatal collisions in the United States varied from 1% to 56% of collisions across states, indicating considerable variability in reporting practices. Worryingly, underreporting of factors contributing to road accidents could potentially lead to a misleading picture of accident causation. This, in turn, may delay the provision of much needed government resources for tackling threats to public health.

Accident reporting practices may also differ depending on driver characteristics, such as driver age and gender. In the United Kingdom, only 54% of drivers involved in road traffic collisions were required to provide a breath test during years 2003 to 2015 (DfT, 2015). This may imply that there is variability in how drivers are approached by officers and asked to undergo testing. In 2015, roadside drug screening was introduced in the United Kingdom, enabling police officers to test for drug impairment for the first time. Thus, road accident statistics from previous years may greatly underestimate the prevalence of drug impairment in crashes. Further, it is not implausible that the characteristics of the driver may be a determining factor in police officers' decisions to request drug testing.

As discussed above, investigating the views of police officers may reveal important discrepancies with accident statistics based on police records, such as when factors are underreported. It may also identify differences in the terminology used by police officers and accident reporting procedures. In the United Kingdom, accident reports provide a fixed set of contributing factors that relate to driver behaviors, such as driver error or reaction and driver impairment, road environment, and vehicle defects. One possibility is that police officers will identify factors that are not included in the list of potential factors available in accident reports and may instead refer to more specific factors, thus revealing insight into accident causation that is not offered by existing accident records.

While police officers may possess valuable insight into the causes of road accidents involving young and older drivers, their views and those of the public, may be inaccurate for specific instances. For instance, collisions of young drivers may often involve exceeding the speed limit, but this will not necessarily be the case for all instances of a collision involving a young driver. Social expectations (e.g., that a collision involving a young driver will have been caused by the teenager exceeding the speed limit) are known to influence information processing and encoding as well as subsequent recall (Macrae et al., 1993; Sherman & Frost, 2000; Stangor & McMillan, 1992). Expectations influence recall depending on whether the information to be recalled is congruent or incongruent with a person's expectations (Stangor & McMillan, 1992). Recall can be better for information that matches than for information that mismatches a person's expectations, particularly under conditions of reduced processing capacity (Macrae et al., 1993; Stangor & Duan, 1991). Under certain conditions, recall can instead be better for incongruent than for congruent information, particularly when the incongruent information is highly salient (e.g., Hastie & Kumar, 1979). For example, learning that a collision was caused by an older driver who was exceeding the speed limit may be particularly salient if it is unexpected. This, in turn, will elicit more extensive cognitive processing of the information, thus leading to better recall.

When recalling factors from memory, police officers may be less influenced than the public by their expectations. Due to their experience reporting on road accidents, police officers may be better at memorizing road accidents details. As such, police officers may be more likely to supress any influence of their expectations on their recall of contributing factors. However, if police officers' expectations do influence their memory recall for the factors involved in collisions of young and older drivers, then this finding could have implications for accident reporting practices. A police officer attending a road accident must manage simultaneously a multitude of cognitively demanding tasks, such as attending to injured persons. They would also need to collect statements from eyewitnesses and road users involved, some of whom may have committed a crime (e.g., driving under the influence of alcohol) and must be detained or require investigation (e.g., completion of a breath test). An attending officer must also minimise further dangers, which may include controlling traffic and ensuring that all road users are accounted for and are safe from further harm. This complex task means that some time may pass before an investigating officer completes their accident report (e.g., parts of the accident report form are completed at the station), potentially affecting the reliability of their report when details must be recalled from memory.

In the current research, we investigated causes of road accidents reported in accident records and compared them with expert views of police officers and lay views of the driving public. In Study 1, police officers and the public were presented hypothetical scenarios of collisions involving drivers of varying ages and gender were asked to generate the factors they believe could possibly have contributed. Doing so enabled us to investigate whether police officers and the public generate the same kinds of factors as those reported in road accident records and whether they associate certain factors with drivers of certain ages and gender. In Study 2, police officers and the public were asked to rate the likelihood that a subset of the generated factors could possibly have contributed to the collisions in the scenarios to further assess their views about the association between contributing factors and driver age and gender. In Study 3, we tested for an influence of expectations on memory recall for contributing factors per age and gender of drivers in the scenarios. Police officers and the public were asked to learn and then recall the factors reported to contribute to collisions in the scenarios.

2. Study 1: generating contributing factors

In Study 1, police officers and the public were presented hypothetical road accident scenarios depicting a collision involving a male or female young, middle age, or older driver. For each scenario, they were asked to generate factors (e.g., exceeding the speed limit) that they believe could possibly have contributed to the collision.

3. Method

3.1. Participants

We recruited 77 (82% male; M_{age} = 43.45 years; SD_{age} = 7.78) police officers from forces across England, UK. Most (N = 69; 90%) were recruited from one of three police forces. Police officers were invited to take part in the study via an email invitation sent to police officers within participating police stations and units. Officers had a mean of 16.90 (range: 3–32 years) years of experience and reported on a mean of 47 (SD = 79.69) road traffic accidents in the last 12 months. The majority (N = 54) worked for a specialist policing unit, which included road policing (N = 30), collision investigation (N = 8), traffic policing (N = 7), counter terrorism (N = 3), emergency response (N = 2), neighbourhood policing (N = 2), and motorcycle unit (N = 1). Seventeen (22%) indicated high school as their highest level of education, 45 (58%) had completed college or third level education (e.g., A-levels, diploma), 12 (16%) had completed an undergraduate degree, and one officer indicated post-graduate education as their highest level of education.

Participants from the public were recruited using Qualtrics®, a private recruitment company. All individuals were residents of England, UK. To avoid age and gender differences between our police officer and public samples, participants were recruited from the public according to 10-year age range and gender quotas, determined by the police officer sample demographics. Hence, our public sample (N = 102; 78% male; M_{age} = 43.45 years; SD_{age} = 8.64) had similar age and gender demographics as our sample of police officers. All participants indicated that they possessed a UK driver license with a mean of 22.76 years (SD = 9.53) of driving experience. The majority were in full-time employment (N = 74), eight were in part-time employment, 12 were unemployed, three were retired, and five indicated that they were a homemaker. Regarding education, 25 indicated high school as their highest level of education, 33 had completed college or third level education, 32 had completed an undergraduate degree, and 12 indicated post-graduate education as their highest level of education. Ethical approval for the research protocol was granted by the institution ethics review board prior to data collection.

3.2. Materials and procedure

All participants were shown six road traffic scenarios in the format: *A driver is involved in a [single-car, two-car] collision. [The driver is, Both drivers are] seriously injured. [The driver, One of the drivers] is a [young driver aged between **17 and 20 years**, middle-aged driver aged between **40 and 49 years**, elderly driver aged **70 years or old**] and is [**male**, **female**]. The collision occurred during the [day between the hours of **6am and 6pm**, evening between the hours of **6pm and 9pm**, night between the hours of **9pm and 6am**].*

For each scenario, participants were asked: “Given this information, please list up to six factors that you think could possibly have contributed to this collision.” The age (17–20, 40–49, $\geq$70 years) and gender of the driver were manipulated within participants across the six scenarios, such that all participants viewed two scenarios of each driver age and three scenarios of each gender. The age ranges were chosen based on the age bandings used by the UK Department for Transport (DfT, 2017) and the UK National Travel Survey (NTS, 2016). The number of vehicles (one-car, two-car) and the time of day (daytime 06:00 h–18:00 h; evening 18:00 h–21:00 h; nighttime 21:00 h–06:00 h) of the collision were counter-balanced across scenarios, using equally each combination of driver age and gender.

3.3. National road accident data

The UK DfT, through the University of Essex Data Archive, UK, provided us the data on all reported motor vehicle collisions involving one and two vehicles occurring in Great Britain (England, Scotland, and Wales) during years 2005–2012. Collisions involved at least one road user injury, including drivers, passengers, pedestrians, and cyclists. The data were provided to the UK DfT by the local processing authority (police, local authority, or local contractor) to be made available for public consumption and are known as STATS19 data (DfT, 2011). Since year 2005, the reporting police officer additionally provided their subjective assessment of the factors they believe to have contributed to the collision. These data partially reflect the reporting officer’s subjective judgment and are recorded for statistical purposes to identify key factors underlying road accident causation (DfT, 2014a). The officer in the contributing factors section of the report selects up to six factors across seven categories, which include road environment (e.g., animal or object in carriageway, defective traffic signs), vehicle defects (e.g., defective or under-inflated tyres, defective or missing mirrors), injudicious actions (e.g., traveling too fast for road conditions, illegal turn or direction of travel), error or reaction (e.g., sudden braking, loss of control), impairment or distraction (e.g., fatigue, distraction in vehicle), behavior or inexperience (e.g., aggressive driving, learner or inexperienced), and vision affected (e.g., dazzling sun, dazzling headlights; DfT, 2014b). The factors vary in their degree of subjectivity, such that some factors (e.g., aggressive driving) are more dependent than others (e.g., defective or missing mirrors) on the officer’s subjective assessment of the accident and on eye-witness reports.

In order to compare the factors generated by participants for hypothetical road accident scenarios with those reported to contribute to real road accidents, road accident records were selected within the STATS19 data according to driver age (17–20, 40–49, $\geq$70 years), gender, number of vehicles involved (one-car, two-car), and time of day (daytime 06:00 h–18:00 h; evening 18:00 h–21:00 h; nighttime 21:00 h–06:00 h).

3.4. Analytic strategy

All participants were shown six road traffic scenarios, including three scenarios for each driver gender and two scenarios for each driver age. To test for statistically significant effects of driver age and gender on the factors generated by participants, we tested for significant differences with age and gender in the likelihood that factors were generated for at least one of the scenarios per driver age and gender. Cochran’s Q test was used for this analysis as this test is suited to related samples of binary data. To test for statistically significant differences in the factors generated by police officers and the public, the chi-square (χ^2) test was conducted, which is suited to independent samples of binary data.

To test for statistically significant effects of driver age and gender on the factors reported in the actual road accident records, Poisson regression analyses was conducted on our data as this analytic approach is suited to count data. An α level of 0.05 was adopted for all our analyses.

Police

	Male drivers			Female drivers		
	Younger	Middle age	Older	Younger	Middle age	Older
Other driver (third party)	3.90	6.49	3.90	2.60	3.90	2.60
Unfamiliar with road (layout, route)	1.30	2.60	2.60	3.90	0.00	6.49
Drugs or alcohol	80.52	74.03	45.45	63.64	70.13	29.87
General driving ability (skills)	6.49	2.60	9.09	7.79	9.09	10.39
Excessive speed	80.52	72.73	32.47	72.73	59.74	24.68
Inexperience	61.04	3.90	2.60	62.34	6.49	7.79
Dangerous driving (peer pressure, showing off)	31.17	9.09	5.19	11.69	1.30	2.60
Distraction (phone, friends, kids, outside)	68.83	55.84	19.48	88.31	67.53	22.08
Driver error (poor judgement)	14.29	11.69	36.36	15.58	22.08	40.26
Road conditions (road layout, road hazard)	20.78	28.57	20.78	28.57	29.87	28.57
Inattention (concentration)	15.58	20.78	25.97	20.78	27.27	15.58
Careless, reckless or in a hurry	12.99	11.69	9.09	15.58	11.69	9.09
Vehicle defects (mechanical failure)	22.08	16.88	12.99	14.29	14.29	9.09
Weather	25.97	29.87	23.38	20.78	31.17	28.57
Overconfidence	7.79	3.90	1.30	1.30	3.90	0.00
Failed to look properly (poor observations)	6.49	9.09	10.39	5.19	5.19	11.69
Traffic	2.60	2.60	2.60	3.90	1.30	3.90
Fatigue	12.99	32.47	19.48	15.58	28.57	19.48
Driving too slow for conditions or slow vehicle	0.00	0.00	0.00	0.00	0.00	3.90
Slow driver reaction	0.00	0.00	20.78	0.00	2.60	22.08
Medical condition (physical impairment, medication)	10.39	35.06	77.92	10.39	23.38	67.53
Poor visibility	5.19	5.19	9.09	6.49	7.79	16.88
Eyesight (uncorrected or defective)	0.00	7.79	57.14	0.00	6.49	53.25
Dazzling light (headlights or sunlight)	1.30	5.19	2.60	0.00	5.19	2.60
Nervous or uncertain (hesitation, confusion, lack of confidence)	0.00	1.30	11.69	2.60	9.09	15.58

Public

	Male drivers			Female drivers		
	Younger	Middle age	Older	Younger	Middle age	Older
Other driver (third party)	9.80	9.80	11.76	4.90	10.78	10.78
Unfamiliar with road (layout, route)	1.96	0.00	2.94	0.98	1.96	1.96
Drugs or alcohol	74.51	50.00	22.55	54.90	38.24	19.61
General driving ability (skills)	1.96	0.98	1.96	2.94	0.98	2.94
Excessive speed	69.61	54.90	23.53	52.94	46.08	23.53
Inexperience	38.24	0.00	0.98	49.02	5.88	2.94
Dangerous driving (peer pressure, showing off)	28.43	4.90	0.00	5.88	3.92	0.98
Distraction (phone, friends, kids, outside)	50.00	34.31	11.76	71.57	53.92	15.69
Driver error (poor judgement)	8.82	15.69	14.71	8.82	9.80	14.71
Road conditions (road layout, road hazard)	16.67	30.39	22.55	20.59	23.53	20.59
Inattention (concentration)	19.61	25.49	24.51	18.63	36.27	24.51
Careless, reckless or in a hurry	16.67	15.69	9.80	12.75	16.67	9.80
Vehicle defects (mechanical failure)	11.76	16.67	14.71	13.73	16.67	15.69
Weather	28.43	33.33	34.31	27.45	36.27	24.51
Overconfidence	3.92	2.94	1.96	2.94	0.00	0.00
Failed to look properly (poor observations)	0.98	0.98	0.98	0.00	0.98	1.96
Traffic	2.94	3.92	4.90	1.96	4.90	4.90
Fatigue	18.63	32.35	30.39	17.65	32.35	31.37
Driving too slow for conditions or slow vehicle	0.00	0.00	2.94	0.00	0.00	0.98
Slow driver reaction	0.00	0.00	19.61	0.00	0.98	18.63
Medical condition (physical impairment, medication)	2.94	19.61	43.14	1.96	14.71	41.18
Poor visibility	17.65	21.57	21.57	17.65	21.57	27.45
Eyesight (uncorrected or defective)	0.98	3.92	37.25	0.98	4.90	30.39
Dazzling light (headlights or sunlight)	2.94	1.96	3.92	1.96	2.94	5.88
Nervous or uncertain (hesitation, confusion, lack of confidence)	0.98	2.94	7.84	4.90	4.90	6.86

Fig. 1. The percentage of police officers and the public who generated each factor per age and gender of the driver in the hypothetical road accident scenarios. The color coding identifies the most frequent (red) to the least frequent (green) factors separately for each driver age and gender. (For interpretation of the references to colour in this figure legend and text, the reader is referred to the web version of this article).

4. Results

4.1. Factors reported for road accident scenarios

Police officers (M = 4.82, SD = 1.10) generated more factors per scenario than the public (M = 4.12, SD = 1.53; independent t-test, $t(177) = 3.44$, $p = .001$). Among police officers, older officers (Pearson correlation, $r(77) = 0.32$, $p = .005$) and more experienced officers ($r(76) = 0.41$, $p < .001$) generated more factors per scenario. Authors SR and JR assigned each of the factors (N = 4760) to a contributing factor category. For example, the factors "poor driving ability" and "competence of the driver" were assigned to the category "general driving ability (skills)". Categories were determined based on similarities across factors and disagreement between the authors was resolved by discussion. Twenty-five categories were produced, which accounted for all generated factors. To assess inter-rater reliability, authors SM and AF each independently assigned a random sample of 100 factors to the 25 factor categories. Authors SM and AF were in 81% and 84% agreement, respectively, with SR and JR about the appropriate assignment of the factors to the factor categories.

Fig. 1 shows the percentage of scenarios for which each of the 25 factors was generated by police officers and the public per driver age and gender. The color coding identifies the most frequent (red) to the least frequent (green) factors for each age and gender scenario. Inspecting Fig. 1, police officers and the public frequently identified drugs or alcohol, excessive speed, inexperience, and distraction as typical factors contributing to young male and female driver collisions. Regarding drugs or alcohol, police officers were more likely to generate this factor for at least one of the scenarios compared to the public (81% vs. 63%; chi square, $\chi^2[1] = 6.65$, $p = .010$). Table 1 provides our statistical analysis for the six most frequently generated factors, which assesses the likelihood of generating a factor for at least one of the scenarios per age and gender of the drivers in the scenarios. The police and the public were influenced by driver age, generating this factor less frequently for older than for young drivers (Fig. 1; Table 1). However, the age-trends differed between police officers and the public as police officers frequently generated drugs or alcohol as a contributor to middle age as well as to young driver collisions (Fig. 1; Table 1). This finding suggests that unlike the public, police officers frequently view drugs or alcohol as typical contributors to collisions of middle age as well as young drivers.

Table 1
Statistical analysis of the effects of driver age and gender on the factors generated by police and the public for the hypothetical scenarios.

	Gender	Age	Middle age vs. young age	Older age vs. age middle
Police				
Drugs or alcohol	0.67	21.31**	0.89	16.33**
Excessive speed	0.82	56.46**	2.00	29.12**
Inexperience	0.82	79.02**	44.00**	0.00
Distraction	7.00**	46.19**	5.44*	21.16**
Medical condition (physical impairment, medication)	5.33*	63.52**	20.17**	19.20**
Eyesight (uncorrected of defective)	2.00	75.17**	8.00**	35.10**
Public				
Drugs or alcohol	3.56	37.68**	8.05**	14.29**
Excessive speed	3.77	58.36**	8.05**	28.13**
Inexperience	9.31**	88.48**	46.00**	0.67
Distraction	10.29**	45.21**	7.14**	19.59**
Medical condition (physical impairment, medication)	1.92	59.21**	17.00**	20.57**
Eyesight (uncorrected of defective)	1.80	67.19**	3.57	31.84**

Note. $^*p \le .05$, $^{**}p \le .01$. The values represent the Cochran's Q scores assessing the likelihood that each factor was generated for at least one of the scenarios per age and gender of the drivers in the scenarios.

Police officers were more likely than the public to generate excessive speed as a typical factor for at least one of the scenarios (87% vs. 77%; Fig. 1), but this difference was not significant (chi square, $\chi^2[1] = 2.67$, $p = .102$). Police officers and the public were strongly influenced by the age of the driver in the scenarios (Fig. 1; Table 1). Excessive speed was less likely to be generated as driver age increased from young to middle age among the public, but not among the police, and especially as driver age increased from middle to older age (Fig. 1; Table 1).

Police officers were more likely than the public to generate inexperience as a typical factor for at least one of the scenarios (66% vs. 51%; chi square, $\chi^2[1] = 4.18$, $p = .041$). Inexperience was frequently reported as a typical factor contributing to the collisions of young male and female drivers (Fig. 1). The police and the public were strongly influenced by driver age (Fig. 1; Table 1). Individual age comparisons revealed that inexperience was significantly less likely to be generated as driver age increased from young to middle age, but not from middle to older age (Table 1). Regarding driver gender, the public, but not the police, were more likely to generate inexperience for young female driver scenarios compared to young male driver scenarios. This finding suggests that the public less frequently views inexperience as a contributor to young male driver collisions than do police officers.

Police officers were more likely than the public to generate distraction as a typical factor for at least one of the scenarios (68% vs. 54% Fig. 1), but this difference did not reach significance (chi square; $\chi^2[1] = 3.38$, $p = .066$). Participants were influenced by the gender of the driver in the scenarios (Fig. 1; Table 1). Police officers and the public were also influenced by driver age (Fig. 1; Table 1). Individual age comparisons revealed that distraction was less likely to be generated as driver age increased from young to middle age, and especially from middle to older age (Table 1).

Medical conditions and poor eyesight were generated frequently for the scenarios (Fig. 1). Police officers were more likely than the public to generate medical conditions (75% vs. 45%; chi square, $\chi^2[1] = 16.47$ $p < .001$), but not poor eyesight (60% vs. 47%; chi square, $\chi^2[1] = 2.83$ $p = .093$), as typical factors for at least one of the scenarios. These factors were strongly associated with driver age (Fig. 1; Table 1). Individual age comparisons revealed that medical conditions and poor eyesight were more likely to be generated by police officers as driver age increased from young to middle age and from middle to older age (Table 1). Medical conditions, but not poor eyesight, were more likely to be generated by the public as driver age increased from young to middle age and from middle to older age (Table 1). Regarding gender, police officers were more likely to report medical conditions as a factor for male than for female drivers (Fig. 1; Table 1).

The time of day of collisions influenced the factors generated in the accident scenarios. Police officers and the public more frequently generated drugs or alcohol as a factor contributing to collisions at night ($\%_{police} = 76$; $\%_{public} = 58$) compared to the evening ($\%_{police} = 62$; $\%_{public} = 41$) than during the daytime ($\%_{police} = 44$; $\%_{public} = 31$). Fatigue was more frequently generated by police officers (37% vs. 16%) and the public (35% vs. 25%) for collisions occurring at night compared to the evening, but not during the evening compared to the daytime ($\%_{police} = 11$; $\%_{public} = 21$). Poor visibility was generated more frequently by police officers (8% vs. 1%) and the public (25% vs. 5%) during the evening than during the daytime and was generated more frequently by police officers (16%), but not the public (33%) for collisions occurring at night compared to during the evening. Police officers further generated distraction (62% vs. 45%) and driver error (25% vs. 15%) more frequently for collisions occurring during the evening compared to during the night. Police officers and the public were not influenced by whether the scenarios involved one or two vehicles.

In sum, police officers and the public identified drugs or alcohol,

	Male drivers			Female drivers		
	Younger	Middle age	Older	Younger	Middle age	Older
Poor or defective road surface	0.80	0.56	0.32	1.14	0.64	0.36
Deposit on road (e.g., oil, mud, chippings	2.12	1.23	0.76	2.63	1.59	0.84
Slippery road (due to weather)	16.55	9.49	5.65	19.29	12.77	5.55
Inadequate or masked signs or road markings	0.44	0.42	0.50	0.61	0.48	0.57
Defective traffic signals	0.11	0.16	0.18	0.17	0.18	0.15
Traffic calming (e.g., speed cushions, road humps)	0.11	0.13	0.27	0.11	0.14	0.28
Temporary road layout (e.g., contraflow)	0.20	0.29	0.33	0.19	0.23	0.23
Road layout (e.g., bend, hill, narrow carriageway)	4.44	2.60	2.48	4.49	2.58	2.49
Animal or object in carriageway	2.36	1.32	0.69	2.36	1.21	0.67
Sunken, raised or slippery inspection cover	0.00	0.00	0.00	0.00	0.00	0.00
Tyres illegal, defective or under-inflated	1.33	0.71	0.41	0.95	0.80	0.48
Defective lights or indicators	0.13	0.14	0.08	0.09	0.10	0.05
Defective brakes	0.52	0.51	0.40	0.47	0.57	0.73
Defective steering or suspension	0.40	0.23	0.29	0.48	0.36	0.25
Defective or missing mirrors	0.01	0.01	0.01	0.00	0.02	0.00
Overloaded or poorly loaded vehicle or trailer	0.09	0.57	0.07	0.05	0.10	0.03
Disobeyed automatic traffic signal	1.31	1.65	1.63	1.32	1.51	1.83
Disobeyed Give Way or Stop sign or markings	2.63	2.68	3.48	3.03	3.12	3.74
Disobeyed double white lines	0.18	0.14	0.14	0.10	0.11	0.12
Disobeyed pedestrian crossing facility	0.25	0.55	1.37	0.31	0.64	1.24
Illegal turn or direction of travel	0.54	0.64	0.66	0.35	0.49	0.57
Exceeding speed limit	11.88	3.36	1.58	4.45	2.28	1.70
Travelling too fast for conditions	19.21	7.83	3.50	12.79	7.09	2.77
Following too close	3.78	4.36	2.41	4.02	4.32	1.97
Vehicle travelling along pavement	0.15	0.23	0.22	0.08	0.17	0.44
Cyclist entering road from pavement	0.30	0.59	0.36	0.34	0.63	0.42
Junction overshoot	2.51	1.88	2.95	2.55	1.94	3.92
Junction restart (moving off at junction)	1.10	1.55	2.11	1.54	1.92	2.42
Poor turn or manoeuvre	11.90	12.18	14.03	11.91	11.05	15.45
Failed to signal or misleading signal	1.26	1.63	1.29	1.35	1.68	1.39
Failed to look properly	23.64	32.95	36.93	26.63	33.64	36.67
Failed to judge other person's path or speed	13.26	15.44	16.71	15.58	15.76	17.31
Too close to cyclist, horse or pedestrian	0.58	1.75	2.17	0.51	1.18	1.76
Sudden braking	7.29	6.33	2.54	7.34	5.09	2.13
Swerved	6.18	3.24	3.45	6.31	3.44	3.23
Loss of control	29.90	12.23	16.21	25.51	13.64	20.60
Impaired by alcohol	7.63	5.31	1.32	3.53	3.59	0.80
Impaired by drugs (illicit or medicinal)	0.67	0.49	0.24	0.18	0.33	0.26
Fatigue	1.44	2.10	2.95	1.01	1.33	2.56
Uncorrected, defective eyesight	0.06	0.07	2.06	0.03	0.10	1.52
Illness or disability, mental or physical	0.38	1.68	10.50	0.54	1.34	7.49
Not displaying lights at night or in poor visibility	0.22	0.23	0.27	0.14	0.19	0.15
Rider wearing dark clothing	0.15	0.31	0.22	0.16	0.25	0.13
Driver using mobile phone	0.26	0.25	0.05	0.38	0.24	0.02
Distraction in vehicle	3.29	1.83	1.67	4.05	2.48	2.40
Distraction outside vehicle	1.44	1.39	1.57	1.60	1.41	1.43
Aggressive driving	7.02	2.26	0.61	1.41	1.01	0.32
Careless, reckless or in a hurry	21.37	12.74	8.09	11.66	10.51	7.98
Nervous, uncertain or panic	1.63	0.86	3.34	4.13	2.00	6.70
Driving too slow for conditions or slow vehicle	0.08	0.09	0.16	0.08	0.04	0.13
Learner or inexperienced driver	21.60	0.98	0.56	25.77	1.47	0.68
Inexperience of driving on the left	0.36	0.49	0.17	0.48	0.22	0.10
Unfamiliar with model of vehicle	1.20	0.48	0.86	1.07	0.57	1.00
Stationary or parked vehicle(s)	2.01	3.36	2.85	2.38	4.26	2.21
Vegetation	0.32	0.37	0.41	0.35	0.46	0.43
Road layout (e.g. bend, winding road, hill crest)	1.77	1.23	1.35	1.76	1.46	1.47
Buildings, road signs, street furniture	0.17	0.26	0.27	0.29	0.27	0.31
Dazzling headlights	0.40	0.32	0.71	0.46	0.30	0.51
Dazzling sun	1.30	2.05	4.73	2.02	2.64	5.20
Rain, sleet, snow or fog	2.03	1.91	1.99	2.58	2.12	1.82
Spray from other vehicles	0.13	0.20	0.23	0.23	0.23	0.12
Visor or windscreen dirty, scratched or frosted etc.	0.14	0.11	0.15	0.16	0.12	0.23
Vehicle blind spot	0.46	2.25	1.06	0.48	1.11	0.82

Fig. 2. The percentage reports of each factor per age and gender of the driver in the road accident records. The color coding identifies the most frequent (red) to the least frequent (green) factors separately for each driver age and gender. (For interpretation of the references to colour in this figure legend and text, the reader is referred to the web version of this article).

excessive speed, inexperience, and distraction as typical of young driver collisions and identified medical conditions and poor eyesight as typical of older driver collisions. Driver distraction was viewed by police officers and the public as more typical of female than of male driver collisions. Compared to the public, police officers more frequently generated factors relating to drugs or alcohol, inexperience, and medical conditions. The public, but not the police, were more likely to generate inexperience for young female than for young male driver scenarios. Police officers frequently generated drugs or alcohol as a contributor to middle age as well as young driver collisions, indicating that police officers frequently view drugs and alcohol as a continuing contributor to collisions into middle age.

4.2. Factors recorded for actual road accidents

We compared the factors generated by police officers and the public in our survey with those assigned in police accident records. The actual road accidents were as comparable as possible to the corresponding hypothetical accident scenarios, in terms of driver age and gender. Fig. 2 shows the percentage of collisions for which each of the 63 factors was recorded by police officers as a contributing factor per driver age and gender. As in Fig. 1, the color coding identifies the most frequent (red) to the least frequent (green) factors for each age and gender collision type. Inspecting Fig. 2, failure to look properly, loss of control, and failure to judge another person's path or speed were the most frequently recorded factors across driver age and gender. Yet, these factors were rarely generated by our participants for the hypothetical accident scenarios. Thus, police officers and the public rarely generated the contributing factors that are most frequently assigned to actual road accidents.

However, being a learner or inexperienced was a frequent factor in the actual collisions of young male and female drivers. Our Poisson regression analysis confirmed that this factor reduced steeply in number as driver age increased from young to middle age (Relative Risk [RR] = 0.06, $p <$ 001). Recall that inexperience was generated frequently by participants as a typical factor in the hypothetical scenarios involving young drivers, especially by police officers. Exceeding the speed limit was more frequently associated with male than female driver collisions in the road accident records (RR = 1.96, $p < .001$). It then decreased steeply in number from young to middle age (RR = 0.34, $p < .001$), and further reduced from middle to older age (RR = 0.63, $p <$. 001). Excessive speed was generated frequently for the hypothetical scenarios and was generated less frequently as driver age increased. Thus, some of the factors generated by police officers and the public for the hypothetical scenarios correspond with factors that were most strongly associated with driver age in the road accident records. As such, participants appear to have generated factors that are most characteristic of the drivers depicted in the scenarios, and in doing so, neglected factors (e.g., failure to look properly) that are prevalent for all drivers.

In the hypothetical scenarios, distraction was generated frequently for collisions involving young drivers, especially for female drivers. In the road accident records, distraction, which includes inside and outside the vehicle and mobile phone use, was not significantly more frequent for female than for male drivers (RR = 1.03, $p = .102$), but was reported less frequently for middle age (RR = 0.85, $p < .001$) and older drivers (RR = 0.90, $p < .001$) compared to young drivers. Distraction was rarely reported in the road accident records (Fig. 2). Further, in the hypothetical scenarios, more instances of distraction referred to mobile phone use ($\%_{police} = 45$; $\%_{public} = 48$) than to distraction inside ($\%_{police} = 31$; $\%_{public} = 35$) and outside the vehicle ($\%_{police} = 24$; $\%_{public}$ 18%). Conversely, using a mobile phone while driving was the least frequently reported distractor in the road accident records (Fig. 2; $RR_{vs.\ inside\text{-}vehicle} = 0.62$, $p < .001$; $RR_{vs.\ outside\text{-}vehicle} = 0.58$, $p < .001$). This discrepancy between participants' views about the hypothetical road accidents and the factors reported in road accident records appears to result partly from an underreporting of mobile phone use in the road accident records or exaggerated beliefs of the police and the public about the dangers of mobile phone use. These possibilities are discussed further in the General Discussion section.

In the road accident records, impairment by alcohol was more frequent among male than female drivers (RR = 1.81, $p <$ 001), and reduced in number from young to middle age (RR = 0.75, $p < .001$), but more so into older age (RR = 0.25 $p < .001$). These tendencies echo the views of participants about the hypothetical scenarios. Drugs or alcohol was generated most frequently for young male driver collisions; and police officers generated this factor frequently for middle age as well as young driver scenarios. However, impairment by alcohol was a rare factor in the road accident records (Fig. 2), suggesting that both the police and the public possess exaggerated beliefs about the dangers of drink driving or that impairment by alcohol is an underreported cause of road accidents. Impairment by drugs was generated less frequently than impairment by alcohol by the police and the public for the hypothetical scenarios and was also less common in the road accident reports. In the road accident reports, impairment by drugs was less frequently associated with older male than young male drivers (RR = 0.30, $p < .001$), but was not less frequently associated with older female than young female drivers (RR = 1.23, $p = .406$). Impairment by drugs in the road accident reports includes illicit and medicinal drugs. The lack of association between drug impairment and age among female drivers could reflect adverse medicinal effects among older women. We return to this possibility in the General Discussion section.

Uncorrected or defective eyesight (RR = 25.00, $p < .001$) and illness or disability (mental or physical; RR = 6.02, $p < .001$) increased in number in the road accident records from middle to older age more so than any other factor (Fig. 2). Similarly, uncorrected or defective eyesight and medical conditions were the factors most frequently generated for older adults by participants for the hypothetical road accident scenarios. However, compared to medical conditions, uncorrected or defective eyesight was reported relatively less frequently in the road accident records (RR = 0.18, $p < .001$; Fig. 2) than by participants for the hypothetical scenarios (Fig. 1).

In sum, the views of police officers and the public reflected some of the typical factors reported to contribute to collisions in road accident records. Inexperience, drugs or alcohol, and exceeding the speed limit were strongly associated with driver age in participants' views about the hypothetical scenarios and also in the road accident records. However, the public, and especially the police, generated some factors, including drugs and alcohol, mobile phone use, and uncorrected or defective eyesight far more frequently than these factors appeared in records of similar road accidents.

5. Study 2: likelihood ratings for contributing factors

In Study 1, some factors that were frequently generated by participants for the hypothetical scenarios were also frequently reported in similar accident records. However, some factors may have been generated because they are highly salient or familiar to police officers and the public, not because they are perceived as likely causes of accidents. As such, the likelihood that a participant generated a factor may not necessarily have reflected their beliefs about the likelihood that the factor contributes to accidents. Therefore, in Study 2, police officers and the public were asked to rate the likelihood that the most frequently generated factors in Study 1 contribute to collisions in the hypothetical scenarios.

6. Method

6.1. Participants

Seventy-two (79% male; $M_{age} = 39.46$ years; $SD_{age} = 8.96$) police officers were recruited from forces in England, UK. Most ($N = 70$; 97%) were recruited from either of two police forces. None had participated in Study 1. Officers had a mean of 13.29 (range: 1–30 years) years of experience and reported on a mean of 74 ($SD = 94.91$) road traffic accidents in the last 12 months. More than half ($N = 45$) worked for a specialist policing unit, including road policing ($N = 29$), collision investigation ($N = 2$), child protection ($N = 2$), traffic policing ($N = 1$), and neighbourhood policing ($N = 1$). Fourteen (19%) indicated high school as their highest level of education, 32 (44%) had completed college or third level education (e.g., A-levels, diploma), 23 (32%) had completed an undergraduate degree, and two officers indicated post-graduate education as their highest level of education.

We recruited a comparison sample of individuals from the public using the same recruitment method as in Study 1. All were residents of England, UK. As in Study 1, participants were recruited according to 10-year age range and gender quotas, determined by the police officer sample demographics. Our public sample ($N = 130$; 79% male; $M_{age} = 41.76$ years; $SD_{age} = 8.61$) had similar age and gender demographics as our sample of police officers. All participants indicated that they possessed a UK driver license with a mean of 20.36 years ($SD = 10.02$) of driving experience.

The majority were in full-time employment ($N = 104$), seven were in part-time employment, seven were unemployed, three were retired, and five indicated that they were a homemaker. Regarding education, 25 indicated high school as their highest level of education, 33 had completed college or third level education, 32 had completed an undergraduate degree, and 12 indicated post-graduate education as their highest level of education. Ethical approval for the research protocol was granted by the institution ethics review board prior to data collection.

6.2. Materials and procedure

All participants were shown the same six road traffic scenarios used in Study 1. However, rather than generate their own factors, participants were shown the six factors most frequently generated by participants in Study 1 (drugs or alcohol, excessive speed, inexperience, distraction, medical condition [physical impairment, medication], eyesight [uncorrected or defective]) and were asked: "Given this information, please rate the following six factors according to how likely you think it is that each could possibly have contributed to the collision." As in Study 1, driver age (17–20, 40–49, $\geq$70 years) and gender were manipulated within participants across the six scenarios and the number of vehicles (one-car, two-car) and the time of day (daytime 06:00 h–18:00 h; evening 18:00 h–21:00 h; nighttime 21:00 h–06:00 h) of the collision were counter-balanced across scenarios.

6.3. Analytic strategy

We used mixed effects analysis of variance (ANOVA) to test for statistically significant effects of driver age and gender on participants' likelihood ratings for each of the six contributing factors. In this analysis, the age (17–20, 40–49, $\geq$70 years) and gender of the driver in the scenario was included as repeated measures factors and police officers versus the public as an independent groups factor. An α level of 0.05 was adopted for our ANOVA on each contributing factor. For our follow-up analyses, a Bonferroni adjusted criterion (i.e., α /no. follow-up comparisons) was employed.

7. Results

Police officers and the public rated how likely they believe each of the six most frequently generated factors in Study 1 could possibly have contributed to the road traffic collisions in the hypothetical scenarios. Fig. 3 shows the mean group likelihood ratings per age and gender of the driver in the scenario. Table 2 provides the results of our analysis of variance (ANOVA) on participants' likelihood ratings for each factor. These analyses revealed that driver age and gender influenced the ratings of police officers and the public about the most likely causes of road accidents.

Drugs or alcohol was rated as less likely to contribute to collisions of female than male drivers and as driver age increased (Fig. 3; Table 2). Compared to police officers, the public rated drugs or alcohol as more likely to contribute to collisions. The effects of driver gender and age differed between police officers and the public (Fig. 3; Table 2). In follow-up ANOVAs it was revealed that compared to the police, the public rated drugs or alcohol as significantly more likely for female ($F(1200) = 8.56$, $p = 0.004$), but not for male ($F(1200) = 2.85$, $p = 0.093$) drivers, indicating that police officers perceived greater gender differences in drugs or alcohol. Further, compared to police officers, the public rated a significantly higher likelihood of drug or alcohol involvement in the collisions of young ($F(1200) = 8.04$, $p = .005$) and older ($F(1200) = 6.72$, $p = .010$) drivers, but did not for middle age drivers ($F(1200) = 0.17$, $p = .677$). As such, compared to the public, police officers perceived a smaller reduction in the likelihood of drug or alcohol involvement as age increased from young to middle age, but a larger reduction in likelihood as age increased from middle to older age.

Compared to police officers, the public rated a higher likelihood of excessive speed contributing to collisions (Fig. 3; Table 2). Participants rated a higher likelihood of excessive speed for male than for female driver collisions and as driver age increased. However, police officers were more sensitive than the public to driver age and the effect of driver age further depended on driver gender (Table 2). Follow-up ANOVAs, conducted separately for each driver age, revealed that the public rated excessive speed as significantly more likely compared to police officers for older drivers ($F(1200) = 14.80$, $p < 0.001$, $\eta^2 = 0.07$), but not for young ($F(1200) = 0.62$, $p = 0.432$) or middle age ($F(1200) = 2.54$, $p = 0.112$) drivers. Thus, police officers in their likelihood ratings distinguished older drivers from young and middle age drivers more so than did the public. Follow-up ANOVAs also revealed that drugs or alcohol was rated as significantly more likely for male than female drivers in young ($F(1200) = 83.91$, $p < 0.001$, $\eta^2 = 0.30$) and middle age ($F(1200) = 40.80$, $p < 0.001$, $\eta^2 = 0.17$), but not in older age ($F(1200) = 0.11$, $p = 0.746$).

Compared to police officers, the public rated a higher likelihood of inexperience contributing to collisions (Fig. 3; Table 2). Likelihood ratings reduced sharply with driver age, specially from young to middle age (Fig. 3). The influence of driver age depended on driver gender. Follow-up ANOVAs revealed that likelihood ratings reduced significantly more steeply with age for male ($F(2400) = 468.79$, $p < 0.001$, $\eta^2 = 0.70$) than for female ($F(2400) = 368.73$, $p < 0.001$, $\eta^2 = 0.65$) drivers.

Compared to police officers, the public indicated a higher likelihood of distraction across scenarios (Fig. 3; Table 2). Distraction was rated as less likely to contribute to male than to female driver collisions and as age increased. However, the effects of driver age differed for police officers and the public and further depended on driver gender (Table 2). Follow-up ANOVAs, conducted separately for each driver age, revealed that while the public did not rate a significantly higher likelihood of distraction for young drivers ($F(1200) = 0.39$, $p = 0.535$) and middle age drivers ($F(1200) = 4.04$, $p = 0.046$, $\eta^2 = 0.02$) compared to police officers after Bonferroni correction, they did rate a significantly higher likelihood for older drivers ($F(1200) = 53.32$, $p < 0.001$, $\eta^2 = 0.21$). As such, police officers were more sensitive than the public to driver age, associating distraction more strongly with young than with middle age and older drivers. Further, participants in general rated a significantly higher likelihood of distraction among female than male drivers in middle age ($F(1200) = 11.52$, $p = 0.001$, $\eta^2 = 0.05$), but not in young ($F(1200) = 6.15$, $p = 0.014$, $\eta^2 = 0.03$) or in older age ($F(1200) = 0.05$, $p = 0.821$) after Bonferroni correction, indicating that participants viewed distraction as more likely among female than male drivers in young age.

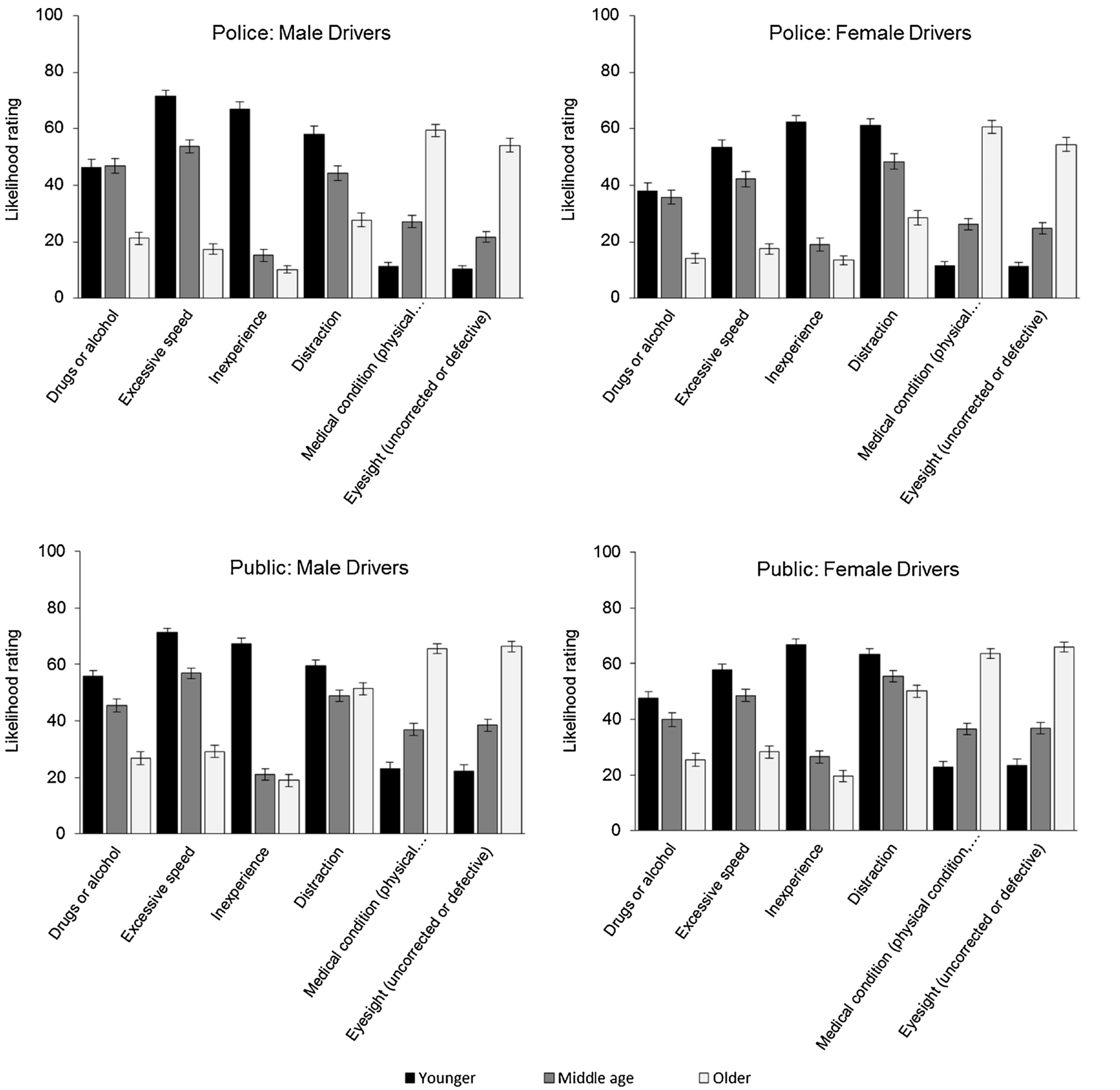

Fig. 3. Ratings by police officers and the public for how likely they believed each factor could possibly have contributed to the road traffic collisions per age and gender of the driver in the hypothetical scenarios. Error bars indicate 1 standard error above and below the mean.

Table 2
Analysis of variance (ANOVA) on the effects of driver age and gender on the likelihood ratings of police officers and the public for each factor.

Variables	Drugs or alcohol	Excessive speed	Inexperience	Distraction	Medical condition (physical impairment, medication)	Eyesight (uncorrected of defective)
Group	6.07*	7.28**	6.55*	16.44**	14.92**	33.41**
Gender	57.10**	76.53**	2.99	9.65**	0.24	0.80
Age	112.66**	380.81**	565.85**	101.19**	423.08**	374.90**
Group by gender	4.48*	1.33	0.48	0.05	0.65	2.04
Group by age	3.11*	5.14**	1.46	27.60**	2.59	0.41
Gender by age	2.72	28.50**	6.92**	4.05*	0.14	0.29
Group by gender by age	1.23	1.01	1.36	0.61	0.86	1.51

Note. *$p \leq .05$, **$p \leq .01$. The values represent F-ratio scores assessing effects on likelihood ratings. The group factor compared police officers (coded 1) and the public (coded 2).

Medical conditions were rated as more likely as driver age increased, especially from middle to older age (Fig. 3). As with medical conditions, poor eyesight was rated as more likely by the public than by police officers (Fig. 3; Table 2). Poor eyesight was rated as more likely to contribute to collisions as driver age increased, especially from middle to older age (Fig. 3).

In sum, drugs or alcohol was rated as more likely to contribute to male than female driver collisions and to the collisions of young drivers. These perceptions resonate with the findings of Study 1 where the drugs or alcohol factor was more frequently associated with young male drivers in the hypothetical scenarios and in the road accident records. Police officers perceived the drugs or alcohol factor as a likely contributor to middle age as well as young driver collisions. These results echo the findings in Study 1 that drugs or alcohol reduced little in frequency from young to middle age in the road accident records. Exceeding the speed limit was rated as most likely to contribute to young male driver collisions, and similarly, was most frequently associated with young male drivers in the hypothetical scenarios and road accident records in Study 1. In addition – also consistent with our findings in Study 1 – inexperience was strongly associated with the collisions of the youngest drivers, and especially among young male drivers, as was found previously for the hypothetical scenarios and road accident reports in Study 1. Participants in general rated distraction as more likely among female than male drivers, but police officers rated distraction as more strongly associated with the collisions of young and middle age drivers than with the collisions of older drivers, echoing findings from the road accident records, especially with regard to mobile phone use (Fig. 1). Finally, medical conditions and uncorrected or defective eyesight were rated by police officers and the public as most strongly associated with the collisions of older drivers. Intriguingly, however, while in Study 1 police officers generated drugs or alcohol, inexperience, and medical conditions more frequently than the public, compared to police officers, the public rated higher likelihoods for all six factors in the scenarios. One possibility is that in Study 1 police officers generated some factors more frequently than the public not because they perceived them as more likely but because the police were more knowledgeable of such factors. This issue is discussed in more detail in the General Discussion section.

8. Study 3: memory recall for contributing factors

In Study 1, police officers and the public generated contributing factors according to the age and gender of the driver depicted in the hypothetical road accident scenarios. In Study 2, they rated a subset of the generated factors as more likely to have contributed to the hypothetical collisions according to the driver's age and gender. In Study 3, we tested for a possible influence of these expectations on their memory recall for factors reported to have contributed to collisions in the scenarios.

9. Method

9.1. Participants

Eighty-three (86% male; M_{age} = 44.13 years; SD_{age} = 7.88) police officers were recruited from forces in England, UK. Almost all (N = 83; 99%) were recruited from either of two police forces. None had participated in Study 1 or Study 2. Officers had a mean of 15.66 (range: 2-34 years) years of experience and reported on a mean of 27 (SD = 36.01) road traffic accidents in the past 12 months. More than half (N = 57) indicated that they worked for a specialist unit, which included road policing (N = 35), collision investigation (N = 9), neighbourhood policing (N = 3), vehicle licensing (N = 1), and road crime (N = 1). Eighteen (22%) indicated high school as their highest level of education, 37 (45%) indicated that they had completed college or third level education (e.g., A-levels, diploma), 23 (28%) had completed an undergraduate degree, and five (6%) officers indicated post-graduate education as their highest level of education.

Following the same recruitment method used in Studies 1 and 2, a comparison sample of individuals was recruited from the public. All were residents of England, UK and were recruited according to 10-year age range and gender quotas, determined by the police officer sample demographics. Our public sample (N = 102; 79% male; M_{age} = 42.67 years; SD_{age} = 9.86) had similar age and gender demographics as our police officer sample. All participants indicated that they possessed a UK driver license with a mean of 21.96 years (SD = 10.24) of driving experience. The majority were in full-time employment (N = 73; 72%), nine were in part-time employment, eight were unemployed, two were retired, two were students, and eight indicated that they were a homemaker. Regarding education, 19 indicated high school as their highest level of education, 48 indicated that they had completed college or third level education, 26 had completed an undergraduate degree, and nine indicated post-graduate education as their highest level of education. Ethical approval for the research protocol was granted by the institution ethics review board prior to data collection.

9.2. Materials and procedure

Participants were shown 12 road traffic scenarios in the format used in Studies 1 and 2. For each scenario, participants were told that one of four factors used in Study 2 was judged by a reporting officer to have contributed to the collision, which read: "The reporting officer judged that **[excessive speed, inexperience, a medical condition (physical impairment, medication), eyesight (uncorrected or defective)]** contributed to the collision." These four factors were selected from the six used in Study 2 as they were most strongly associated with driver age in the hypothetical scenarios.

The four factors were presented three times to each participant across the 12 scenarios. For each participant, each factor was used for each driver age (17–20, 40–49, $\geq$70 years), such that the factors were used equally per driver age. Driver gender, the time of day of the accident (daytime 06:00 h–18:00 h; evening 18:00 h–21:00 h; nighttime 21:00 h–06:00 h), and the number of vehicles involved (one car, two-car) were also manipulated. To assign the factors equally to driver gender, time of day, and number of vehicles involved, 12 stimulus sets were generated. Participants were randomly assigned to one of the 12 stimulus sets. Thus, each factor was assigned equally to each characteristic of the scenario across the 12 stimulus sets. This approach ensured variation across the scenarios, such that each scenario was unique in terms of the factor involved, the driver age and gender, time of day, and the number of vehicles involved.

Participants were told that for each scenario they would be asked to input on the computer the key features of the collision, including the age and gender of the named driver, the number of vehicles involved, the time of day of the collision, and the factor (e.g., exceeding the speed limit) reported by the police officer to have contributed to the collision. This was done to ensure that they reviewed the information provided. Participants were asked not to make any additional notes (e.g., using paper and pencil) about the scenarios that could be used later. For each scenario, they were asked to report the driver's age ("What is the age of the driver in the scenario?"), gender ("What is the gender of the driver in the scenario?"), the number of vehicles involved ("How many cars were involved in the collision?"), the time of day ("During what time of day did the collision occur?"), and the factor identified by the reporting officer to have contributed to the collision ("What did the reporting officer judge to have contributed to the collision?"). After completing their report, participants moved to the next scenario. The scenarios were presented in a randomly generated order for each participant.

In a test phase, which immediately followed completion of the 12 scenarios, participants were shown a second time the 12 scenarios individually in a randomly generated order and were told: "Previously, you were asked to imagine the following scenario:". Below the scenario,

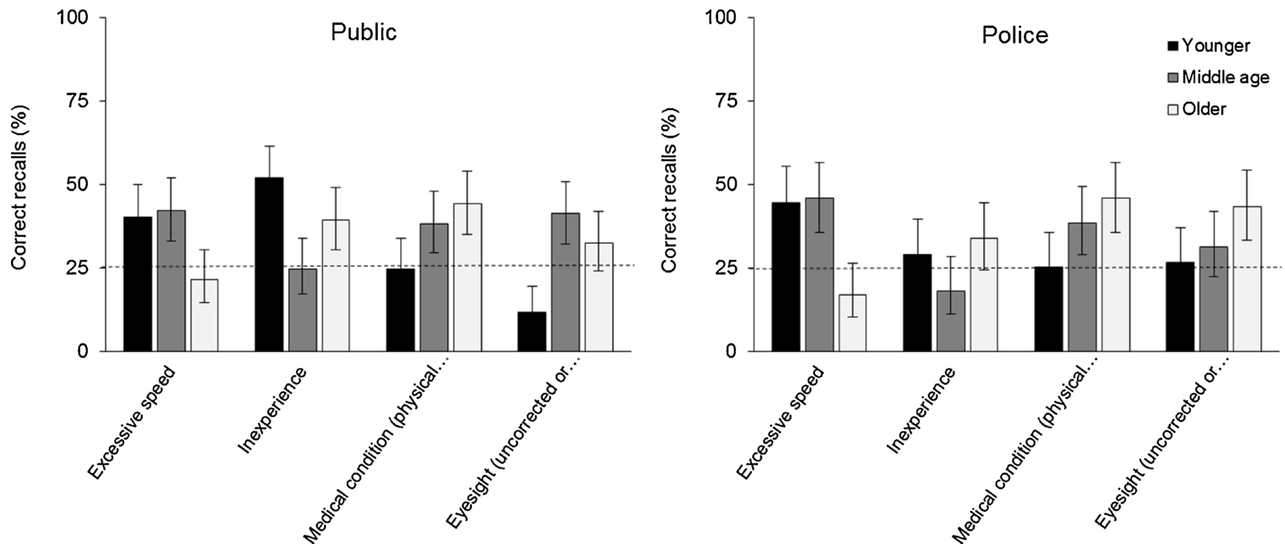

Fig. 4. Percentage of correct recalls for each factor reported to have contributed to the road traffic collisions per age of the driver in the hypothetical scenarios. The horizontal dashed line indicates chance level. Error bars indicate the 95% confidence intervals above and below the mean.

participants were asked to enter the factor indicated by the reporting officer to have contributed to the collision, which read: "What did the reporting officer judge to have contributed to the collision in the scenario?". Participants rated their confidence in their answer ("How confident are you in your answer?") on a continuous scale from 0 to 100. Each scenario was presented on a separate screen to ensure that participants could not return to correct previous responses. The study instructions did not state to participants that their memory would be assessed. Participants were told only that after reviewing the scenarios they would be asked about each scenario and that the purpose of the study would be explained at the end of the study.

9.3. Analytic strategy

Cochran's Q test for related samples was used to test for statistically significant effects of driver age and gender on memory recall for each factor. The chi-square (χ^2) test was used to test for statistically significant differences in memory recall between police officers and the public. An α level of 0.05 was adopted for all our analyses.

10. Results

Police officers and the public were asked to recall for each scenario the factor indicated by the reporting officer to have contributed to the collision. Fig. 4 shows the percentage of correct recalls for each of the four contributing factors per age of the driver in the scenario, collapsed across driver gender. The data were collapsed across gender to maximise statistical power as the trends were generally similar for male and female driver scenarios. A chance level of 25% was adopted as four factors were used repeatedly across scenarios.

The age of the driver in the scenario influenced correct recall of excessive speed among police officers (Q = 19.40; $p < .001$) and the public (Q = 13.43; $p = .001$; Fig. 4). Individual comparisons revealed that participants were significantly less likely to recall correctly excessive speed for collisions involving older drivers than for collisions involving young ($Q_{police} = 14.30$; $p < .001$; $Q_{public} = 8.81$; $p = .003$) and middle age ($Q_{police} = 15.16$; $p < .001$; $Q_{public} = 11.31$; $p = .001$) drivers. Correct recall was significantly above chance level for collision scenarios involving young ($\chi^2[1]_{police} = 6.78$; $p = .009$; $\chi^2[1]_{public} = 5.00$; $p = .025$) and middle age ($\chi^2[1]_{police} = 7.60$; $p = .006$; $\chi^2[1]_{public} = 6.33$; $p = .012$) drivers, but not for scenarios involving older drivers ($\chi^2[1]_{police} = 1.77$; $p = .183$; $\chi^2[1]_{public} = 0.44$; $p = .509$). There were no significant differences between police officers and the public in their percentage of correct recalls.

An influence of driver age on correct recall of inexperience was significant among the public (Q = 16.36; $p < .001$), but not among police officers (Q = 5.12; $p = .077$). Among the public, correct recall was significantly better for collisions involving young drivers compared to collisions involving middle age drivers (Q = 14.52; $p < .001$), but not compared to collisions involving older drivers (Q = 3.19; $p = .074$). Further, among the public, correct recall was significantly better for older driver and for middle age driver scenarios (Q = 6.08; $p = .014$) and was significantly above chance level for young ($\chi^2[1] = 15.06$; $p < .001$) and older ($\chi^2[1] = 4.39$; $p = .036$) driver scenarios, but not for middle age driver scenarios ($\chi^2[1] = 0.03$; $p = .872$). Therefore, while the public was influenced by driver age in their memory recall, this was mainly because their memory was particularly poor for middle age driver scenarios involving inexperience.

When a medical condition was identified as having contributed to a collision, driver age influenced recall among police officers (Q = 7.56; $p = .023$) and the public (Q = 8.78; $p = .012$), whereby recall improved as driver age increased (Fig. 3). Individual comparisons confirmed that participants were significantly more likely to recall correctly a medical condition for collisions involving older drivers than for collisions involving young drivers ($Q_{public} = 8.33$; $p = .004$; $Q_{police} = 7.05$; $p = .008$) and for middle age drivers compared to young drivers among the public (Q = 4.08; $p = .043$), but not among police officers (Q = 3.10; $p = .078$). The percentage of correct recalls was significantly above chance level for older driver scenarios ($\chi^2[1]_{police} = 7.60$; $p = .006$; $\chi^2[1]_{public} = 7.80$; $p = .005$), approached significance for middle age driver scenarios ($\chi^2[1]_{police} = 3.35$; $p = .067$; $\chi^2[1]_{public} = 3.82$; $p = .051$), and was not significantly above chance for young driver scenarios ($\chi^2[1]_{police} = 0.00$; $p = .100$; $\chi^2[1]_{public} = 0.03$; $p = .872$).

An influence of driver age on correct recall of poor eyesight was significant among the public (Q = 22.43; $p < .001$), but did not reach significance among police officers (Q = 5.20; $p = .074$). However, an individual comparison did reveal that police officers were significantly more likely to recall poor eyesight correctly for collision scenarios involving older drivers than for scenarios involving young drivers (Q = 4.90; $p = .027$; Fig. 4). Among the public, memory recall was significantly better for collision scenarios involving older (Q = 13.36; $p < .001$) and middle age (Q = 19.56; $p < .001$) drivers compared to scenarios involving young drivers. The percentage of correct recalls was significantly above chance level among the public for middle age drivers ($\chi^2[1] = 5.65$; $p = .017$) and older drivers and among police officers for older drivers ($\chi^2[1] = 6.01$; $p = .014$). Moreover, the percentage of correct recalls was actually significantly below chance level for young drivers among the public ($\chi^2[1] = 6.34$; $p = .012$).

In general, police officers ($M = 48.15$; $SD = 23.11$) and the public ($M = 45.49$; $SD = 21.02$) were slightly more confident in their correct recalls than they were for their incorrect recalls ($M_{police} = 45.40$; $SD = 21.75$; $t(80) = 2.17$; $p = .033$; $M_{public} = 42.98$; $SD = 19.75$; $t(100) = 2.22$, $p = .028$).

11. General discussion

We assessed the causes of road accidents involving young, middle age, and older male and female drivers reported in accident records and compared these with expert views of police officers and lay views of the driving public. Police officers and members of the driving public were asked to generate factors they think could possibly have contributed to hypothetical collisions involving drivers of varying ages and gender. Police officers and the public identified the factors that were typically associated with actual collisions of young and older drivers. Drugs or alcohol and excessive speed were frequently generated for the young driver accident scenarios. This finding suggests that risk taking is viewed as an important contributing factor for this age group. Inexperience and driver distraction were also generated frequently for both young driver scenarios and actual collisions. Conversely, police officers and the public generated medical conditions and uncorrected or defective eyesight as typical factors for older driver scenarios. These contributing factors were typically attributed to actual police-reported collisions involving older drivers. Moreover, the likelihood ratings for these factors as a function of drivers' age mimicked their actual association with driver age in the accident records. Thus, our findings suggest that the views of police officers and of driving public accurately reflect some of the most characteristic factors that contribute to road traffic collisions of young and older drivers.

Police officers were more knowledgeable of some factors contributing to young and older driver collisions than the public. Specifically, compared to the public, police officers more frequently generated drugs or alcohol, inexperience, and medical conditions according to the age of the driver in the scenarios. However, police officers and the public did not differ in terms of likelihood of ratings for these factors. As such, police officers appeared to be more aware than the public of these factors as typical causes of young and older driver collisions. Unlike the public, police officers also generated drugs or alcohol frequently for collisions involving middle age as well as young drivers and did not rate a lower likelihood of drug or alcohol impairment as age increased from young to middle age. Echoing the views of police officers, impairment by alcohol reduced little in number from young to middle age in the police accident records. For some factors, police officers were also more sensitive than the public to driver age in the scenarios, associating distraction more with young drivers than with middle age and older drivers. Close to half of the instances of distraction that participants generated referred to mobile phone use. Mobile phone use reduced steeply in number with driver age in the road accident records. These findings indicate that police officers were particularly sensitive to the association between driver age and mobile phone use in road traffic collisions.

Our investigation of police officers' views also revealed some interesting discrepancies with the factors reported in road accident records. While police officers (and the public) frequently generated instances of driver distraction for the hypothetical scenarios, this factor was rarely reported in the accident records. This discrepancy was due partly to more frequent reference to mobile phone use as a factor in the hypothetical scenarios than in the accident records. Either mobile phone use is an underreported factor in road accidents or police officers (and the public) possess exaggerated beliefs about the dangers of using mobile phones while driving. A wealth of research has shown that driver distraction, and in particular, mobile phone use, raises the risk of road traffic collisions (Klauer et al., 2014; McEvoy et al., 2005; Redelmeier & Tibshirani, 1997). In a naturalistic study, in which drivers' vehicles were equipped with monitoring devices, Klauer et al. (2014) found that various distractions, including reaching for an object in the car, eating, and looking at roadside objects elevated the risk of a crash or near crash among young novice drivers. Interestingly, mobile phone use increased the risk of a crash or near crash among young novice as well as experienced drivers. Dingus et al. (2016) further found that engagement in a secondary task distracted drivers more than 50% of the time while driving, doubling their risk of a collision. Although driver's mobile phone records can be investigated by law enforcement, reports of driver distraction in road accidents vary by as much 1%–56% across states in the United States (NHTSA, 2009). Given the considerable variation in accident reporting practices and our current findings, it appears that distraction, and particularly mobile phone use, may be an underreported cause of collisions in road accident records. If mobile phone use and other forms of distraction are underreported in accident records, this could potentially undermine the reliability of road accident statistics.

In the United Kingdom, just over half of drivers involved in a road traffic accident have typically been required to provide a breath test for alcohol impairment (DfT, 2015). In 2015, roadside drug testing was introduced in the United Kingdom, before which law enforcement were unable to test for drug impairment at the roadside. Consequently, there is great potential for underreporting of drug and alcohol impairment in road accident records. In support of this notion are our findings that despite being rarely reported in accident records, drug or alcohol impairment was among the factors most frequently generated by police officers and the public. Additionally, drug or alcohol impairment was rated as a likely contributor to collisions. Thus, our findings foresee that drug impairment may become much more frequent in road accident reports in following years since the introduction of roadside drug testing. Our findings further suggest that as breath tests for alcohol impairment are not routinely required for drivers involved in road accidents, alcohol impairment may be a greatly underestimated cause of road traffic accidents. Underreporting due to inconsistent law enforcement practices may also explain why uncorrected or defective eyesight was frequently generated as a factor by police officers (and the public), but was rarely reported in the accident records. Policymakers rely on road accident statistics to inform their recommendations and new policy initiatives. Based on our current findings, we recommend that police officers and policymakers be cognizant of potential underreporting of factors associated with driver risk.

Accident reports typically provide a fixed set of contributing factors (e.g., failure to look properly) that the police officer must select to identify the causes of a road accident. A fixed set of factors may not contain all factors relevant to accident causation and new causes of road accidents may emerge over time, requiring updating of the factor list. Investigating the views of police officers and the public is one method of identifying aspects of accident reports that require updating. Police officers and the driving public frequently generated examples of "dangerous driving (peer pressure, showing off)" for scenarios involving young drivers, especially male drivers (Fig. 1). This factor appears to reflect risk taking (Braitman et al., 2008; Rolison et al. 2014) and sensation seeking (Bachoo et al., 2013; Jonah, 1997) in young adulthood and the influence of peers on young drivers (Hatfield & Fernandes, 2009; Simons-Morton et al., 2011). The United Kingdom accident report includes "careless, reckless or in a hurry" (Fig. 2), but this factor does not refer specifically to dangerous driving and may include a variety of unrelated actions and behaviors—a driver may be in a hurry because they are impatient, late for a work meeting, or because they need urgent medical care and are making their way to a local hospital.

Police officers and the driving public also generated examples of driver "inattention (concentration)" in addition to generating examples of driver "distraction (phone, friends, kids, outside)". In recent years, road safety researchers have distinguished distraction and inattention as separate factors contributing to road accidents. Distraction is defined by instances in which a driver's attention is diverted from the activity of driving by a competing activity (e.g., using a mobile phone, adjusting a car stereo), whereas inattention refers to a failure to allocate attention to the activity of driving, such as if a driver engages in day-dreaming (Regan et al., 2011; Regan et al., 2008). The United Kingdom road accident reports do not currently identify inattention as a possible contributor to accidents, and so may be failing to record an important factor in road accidents.

Finally, police officers and the public identified "slower driver reactions" as a typical cause of collisions involving older drivers, echoing road safety research that has identified visual, cognitive, and mobility decline as risk factors for older driver collisions (e.g., Ball et al., 2006; 2010). In fact, slower driver reactions may be an intermediate factor caused by decline in visual, cognitive, and mobility function that leads to driver errors when making turns and at intersections (Hakamies-Blomqvist, 1993; Langford & Koppel, 2006; McGwin & Brown, 1999). Moreover, driver reaction is an ability that could easily be assessed with simple reaction time tasks, which could be included in screening tests to assess driver fitness, especially among older drivers.

Failure to look properly, loss of control, and failure to judge another person's path or speed were the most frequently reported factors in the road accident records, but were rarely generated by police officers and the public for the hypothetical scenarios. Participants instead focussed on factors that were most strongly associated with driver age and gender in the accident records, neglecting those that were most prevalent across all drivers. Previous research has shown that recall can be better if the information to be recalled matches a person's expectations (Macrae et al., 1993; Stangor & McMillan, 1992). In Study 3, we tested for an influence of participants' expectations on their memory recall for factors associated with hypothetical scenarios. Participants were given many hypothetical scenarios to force memory errors at the recall stage, such that participants' prior expectations about the scenarios could feed into their recall. Accordingly, the expectations of police officers and the public about accident causation influenced their recall for the factors reported to contribute to collisions in the scenarios. Recall accuracy was better for drugs or alcohol, excessive speed, inexperience, and distraction for scenarios involving young drivers and was better for medical conditions and uncorrected or defective eyesight for scenarios involving older drivers. Our findings do not suggest necessarily that memory retrieval was distorted by prior expectations. In general, participants reported low confidence in their recall accuracy, indicating that when memory failed they may have guessed about the most likely factor for a scenario, relying heavily or entirely on their prior expectations. Nevertheless, our findings do suggest that when memory for contributing factors fails, police officers and the public incorporate their prior expectations, rather than guess randomly. When a police officer attends a road accident, they must simultaneously engage in multiple cognitively demanding tasks, such as attending to injured road users and minimising further dangers as well as investigating the causes of the accident. Memory may fail under these demanding conditions, perhaps either due to interference or shallow processing, and later recall may then be influenced by prior beliefs about the typical factors involved in similar accidents. Our findings suggest that time delay before an accident report is completed could lead to memory distortions that affect the reliability of the accident report.

In sum, our investigation of the views of police officers and the driving public revealed potential underreporting of existing factors in accident records. These results point to inadequacies in how law enforcement investigates driver distraction, drug and alcohol impairment, and uncorrected or defective eyesight. Our findings further identify a need for contributing factor lists in accident reports to be continuously reviewed and updated to ensure that accident statistics reflect the full range of factors that contribute to road accidents. Although the views of police officers reflected some of the typical factors associated with the collisions of young and older drivers, their expectations about accident causation influenced their recall for the factors involved in hypothetical road accident scenarios. These results may imply a need to reduce possible delay in completing accident report forms, such as by using mobile reporting devices (e.g., mobile apps) that enable officers to complete their report at the scene of the accident.

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