# Identifying a broad range of psychological characteristics associated with unsafe driving behaviors

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A B S T R A C T

Unsafe driving behaviors (UDBs) represent one of the most consequential classes of behavior in public health. The present study aims to identify a greater range of psychological and behavioral characteristics associated with UDBs, with a special focus on identifying characteristics varying in their associations with different UDBs. Data was analyzed from the Eugene-Springfield Community Study (ESCS) linking self-ratings of the 2539-item International Personality Item Pool (IPIP; Goldberg et al., 2006) to self-reports of four UDBs: speeding, driving after drinking alcohol, driving without a seatbelt, and consuming food or drinks while driving. A subset of 176 IPIP items were identified as having non-trivial relations with the four UDBs, which were then organized into 20 more specific clusters. Some groups were commonly predictive of all four UDBs, such as tendencies to break rules, to view cheating as acceptable, or to talk impulsively. Others were mainly predictive of one UDB but not others. For instance, religiosity was uniquely predictive of lower tendencies to drive after drinking alcohol, whereas negative self-perceptions were uniquely predictive of greater tendencies to drive without a seatbelt. The results provide a more molecular, fine-grained picture of the characteristics associated with UDBs, which can inform larger models of why people engage in UDBs, and why they perform some but not others.

## 1. Introduction

Transportation safety researchers and organizations regularly cite unsafe driving behaviors (UDBs) such as *speeding, failure to use seatbelts,* and *drunk driving* as among the central causes of crashes, injuries, and fatalities involving automobiles (Khan et al., 2007; Mohammed et al., 2019; NHTSA, 2024; Singh, 2017; Touahmia, 2018), which in turn remains a leading cause of death in the United States and around the world (CDC, 2024; WHO, 2024). A better understanding of the characteristics that make people more likely to engage in UDBs has consequently been an important priority for research, as this can help to inform more effective countermeasures (Kirley et al., 2023).

The present study aims to contribute to our understanding of the characteristics that are associated with UDBs in two ways. First, a number of research practices have increased the difficulty of contrasting the characteristics associated with different UDBs. In-vestigations will often focus narrowly on identifying characteristics associated with a single UDB, such as *speeding* (Sàrbescu & Rusu, 2021), *drunk driving* (Stacy et al., 1991), or *seatbelt use* (Goudie et al., 2014; Reagan et al., 2013). Other investigations will measure multiple distinct UDBs, but combine measures of distinct UDBs into larger scale scores. For instance, within the Behaviour of Young

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Novice Drivers Scale (BYNDS; Scott-Parker et al., 2012), items related to *speeding, taking illegal U-turns,* and *speaking on a mobile phone* while driving are averaged into a single scale score representing *transient rule violations*; and items related to *speeding, drunk-driving*, and other distinct UDBs are combined into a single *driving violations* score within the Driving Behavior Questionnaire (DBQ; (Reason et al., 1990), and a single *risky driving* score within the Dula Dangerous Driving Index (DDDI; Dula & Ballard, 2003). Similarly, studies of different UDBs are sometimes combined into a single category within a meta-analysis. For instance, a recent meta-analysis by Akbari et al. (2019) combined studies specifically about *speeding, texting while driving,* or *driving while drunk* together to examine the personality correlates of "risky driving." These research practices are likely prompted by different UDBs generally correlating positively with one another – for instance, people with higher rates of drunk driving are more likely to speed or drive unbelted (Briggs et al., 2008; Stübig et al., 2012; Bogstrand et al., 2015; Adanu et al., 2022). However, these practices make it more difficult to identify how psychological characteristics vary in their associations with different specific UDBs. Many researchers understand that diverse expectancies and values combine to make separate contributions to the overall likelihood of engaging in a particular UDB (e.g., $\sum e_i v_i \rightarrow B$; Elliott et al., 2005, 2007; Le et al., 2023, 2024; Parker et al., 1996). For instance, speeding behavior might be increased by expectancies like "I believe speeding will help me be punctual" and "I don't think I'll get into a car crash if I speed" and by associated values like "it is very important to me to be punctual" and "I don't care about my physical health," among many others. Each of these expectancies and values in turn may be affected by diverse demographic and environmental factors (Adanu et al., 2019). Although distinct UDBs are likely to share some contributing beliefs, others will be more unique to particular behaviors. For instance, *being less concerned with your own physical well-being* may promote many UDBs simultaneously (e.g., increased speeding and drunk driving, lower seatbelt use), whereas *wanting to be punctual* may more narrowly promote speeding and play a more negligible role in affecting seatbelt use and many other important UDBs. More generally, specific UDBs are likely to have their own distinct and differentiable systems of psychological characteristics that make the behavior more or less likely, and these nuances are lost when distinct behaviors are combined.

Second, researchers examining the characteristics predictive of higher rates of UDBs will typically limit their investigations to a relatively small number of psychological characteristics. For instance, there are many studies which have explored how UDBs are associated with individual differences in *sensation-seeking* or *aggressiveness* (e.g., Zhang & Chan, 2016; Zhang et al., 2019), or with measures of the Big Five personality traits (Clarke & Robertson, 2005; Dahlen & White, 2006; Luo et al., 2023). Although these are important relationships to establish, any specific behavior should generally be understood as shaped by many characteristics which each make distinct contributions to the behavior (Ahadi & Diener, 1989; Baumert et al., 2017; Wood et al., 2015). Many of the characteristics playing non-trivial roles in shaping a person's likelihood of engaging in any specific UDB likely remain to be more fully identified.

### 1.1. Present study

The present study will be conducted in the tradition of *descriptive* or *discovery* research (e.g., (Block, 1961; Condon et al., 2020; Funder, 2009; Mõttus et al., 2020; Revelle et al., 2020; Wood et al., 2015), aiming to uncover a wide range of psychological or behavioral characteristics associated with consequential UDBs, and detailing how these characteristics vary in their associations across different UDBs. To promote this goal, items indicating both an individual's psychological tendencies or rates of UDBs will not be aggregated at the initial stage of the analysis. Rather, groups of similar items will only be formed among a subset of items showing non-trivial relationships with UDBs.

This analysis strategy represents an inversion of the more usual research practice of averaging items into multi-item scales before correlating them with one another. The more usual research practice of first averaging items into multi-item scales will regularly result in the loss of information which could add to the prediction of the outcome of interest (Elleman et al., 2020; Revelle et al., 2020; Wood et al., 2023). It also may obscure other problems, such as the regular tendency for scales to relate to one another due to content overlap (Cooper, 2024; Mõttus, 2016; Nicholls et al., 1982; Wood & Harms, 2016).

The present investigation will utilize data from the Eugene-Springfield Community Sample (ESCS), where between 1993 and 2006 participants completed both one of the most diverse item pools ever employed for research on personality and individual differences – the 2539-item *International Personality Item Pool,* or *IPIP* (Goldberg et al., 2006) – as well as rating their frequency of engaging in some common UDBs, specifically *speeding, driving without a seatbelt, driving after consuming alcohol*, and *driving while eating and drinking*.

## 2. Method

### 2.1. Participants

The initial sample targeted homeowners living near Eugene and Springfield, Oregon, who agreed to complete mailed surveys for at least five to ten years. All surveys were completed anonymously with identification numbers used to match responses, and participants received between $10 and $25 for each completed survey. Participants ultimately were contacted to complete over 20 surveys over the 14-year period from 1993 to 2006, with 88 % ($N = 757$) of the original sample completing two of the final four questionnaires, demonstrating good participant retention. In 1993, participants in the original sample ranged in age from 18 to 85 ($M = 51$), 98 % reported their ethnicity as Caucasian, and 57 % reported their gender as female (Goldberg, 2008; Grucza & Goldberg, 2007).

### 2.2. International personality item pool (IPIP)

A major focus of the IPIP was to assist in creating open-source alternatives to proprietary personality scales, and research has

indicated that scales created from IPIP items have comparable reliability and validity to such scales (Johnson, 2014). However, the IPIP items were not developed to create particular scales, but rather to consist of simple phrases that could be readily translated into different languages, and to be sufficiently diverse that a wide range of individual difference dimensions could be scored from items within the larger pool (Goldberg, 1999; Goldberg et al., 2006).

All IPIP items consisted of simple phrases in the form of self-descriptions rated under a common instruction to "Please use the rating scale below to describe how accurately each statement describes you", on a scale with labeled values of 1 = "Very Inaccurate", 2 = "Moderately Inaccurate", 3 = "Neither Inaccurate nor Accurate", 4 = "Moderately Accurate", and 5 = "Very Accurate". Responses were rescaled to range from −1 to 1, such that item means below or above 0 indicate normative tendencies to see the items as inaccurate or accurate, respectively.

### 2.3. Unsafe driving behaviors (UDBs)

In 1997, a total of 778 ESCS participants completed the *Behavioral Report Inventory*, or *BRI*, consisting of a broad-ranging set of 400 activity descriptions (Goldberg, 2009). Participants rated the frequency with which they had performed each behavior on a scale with labeled values of 1 = "NEVER in my life", 2 = "Not in the past year", 3 = "ONCE or TWICE in the past year", 4 = "THREE or MORE times in the past year, but not more than 15 times (such as once or twice a month)", to 5 = "MORE THAN 15 TIMES in the past year".

Four of the 400 items were determined to concern items related to NHTSA (2024) descriptions of top priority UDBs. These items were "Drove a car over 75 miles per hour", "Drove or rode in a car without a seatbelt", "Drove a car after having a few alcoholic drinks", and "Ate or drank while driving"; these will be referred to more briefly as concerning *speeding, driving while unbelted, driving after drinking,* and *eating while driving*, respectively. Note that the first three behaviors most directly parallel items in other self-report measures of UDBs, such as the DBQ (Reason et al., 1990), BYNDS (Scott-Parker et al., 2012), and DDDI (Dula & Ballard, 2003). The final behavior – eating while driving – was considered a contributor or manifestation of distracted driving, but is both less reflected in UDB inventories and varies more widely in the degree to which is regarded as an important contributor to distracted driving and accident risk by safety researchers (Dingus et al., 2016; NHTSA, 2024b; Schroeder et al., 2013; Vegega et al., 2013).

The BRI instrument also contained the item "Drove while talking on the phone", however this item was not examined in this study, as the nature of what it meant to engage in this behavior likely changed substantially from the time the data was collected in 1997 to the present. Specifically, it was rare for drivers to own mobile phones in 1997. (As a point of reference: the first iPhone was released a decade later, in 2007.) Further, this item had a mean rating of 2.06, indicating that at the time ratings were made in 1997, these participants reported talking on the phone even less frequently than they engaging in driving after drinking (Table 1).

As respondents also rated how frequently they "Drove a car" within the BRI, analyses were restricted to individuals that described driving a car frequently – i.e., rated this item with a response of "5" to indicate they drove 15 or more times in the past year. This exclusion was made to reduce the possibility that associations with the UDBs would be more indicative of whether a person drove a car at all rather than whether they engaged in the UDB when they had relatively frequent opportunities to do so. This restriction reduced the analysis sample from 778 to 748 respondents.

### 2.4. Analysis

#### 2.4.1. Identifying items related to UDBs

Analyses were restricted to a smaller set of IPIP items that met one of the two criteria.

(1) **Showed meaningful associations with at least one of the measured UDBs.** More specifically, items were included if they showed a partial correlation exceeding $|r| > 0.15$ in magnitude with at least one of the UDBs, partialling out associations of age and gender.

(2) **Showed meaningful variation in associations with the measured UDBs.** Items were additionally included if showing partial correlations differing by at least a 0.20 magnitude across any of the four UDBs.

Both rules operationalized inclusion at a level far above the $p < 0.05$ threshold conventionally used to judge statistical significance, and these thresholds were selected principally to restrict all correlations presented to those expected to occur less than 1 time in 1,000 within the present sample by chance. Specifically, as all correlations in the present analysis were based on between 591 and 748 participants, the likelihood of a $|r| = 0.15$ association occurring by chance is $p = 0.00025$, and the likelihood of two correlations

**Table 1**
Intercorrelations between Unsafe Driving Behaviors, Controlling for Gender and Age.

| Variable | Unsafe driving behavior (UDB) | M | (SD) | Correlations | | |
| | | | | Speeding | Unbelted | Alcohol |
|---|---|---|---|---|---|---|
| Speeding | Drove a car over 75 miles per hour. | 2.86 | (1.03) | | | |
| Unbelted | Drove or rode in a car without a seatbelt. | 2.49 | (0.91) | 0.124 | | |
| Alcohol | Drove a car after having a few alcoholic drinks. | 2.24 | (1.03) | 0.225 | 0.122 | |
| Eat/Drink | Ate or drank while driving. | 3.57 | (1.21) | 0.176 | 0.166 | 0.068 |

*Note.* All Ns ≥ 746.

differing by at least 0.20 is $p = 0.00057$ (and will be lower than this if the two variables are positively correlated). Analyses were conducted using the r.test function in psych package of R (Revelle, 2017). The joint consideration of these rules resulted in including 176 IPIP items for further analysis, or 7 % of the full 2539-item pool.

### 2.4.2. Identification of narrower item groups related to UDBs

Hierarchical cluster analysis (HCA) was used to organize the resulting 176 items into groups of more highly inter-correlated items, using the Ward's $D^2$ clustering algorithm (Murtagh & Legendre, 2014). The procedures were similar to those employed by Wood and colleagues (2010, 2015) and Arumäe et al. (2024) for identifying a broad array of more specific item groups related to outcomes of interest.

Specifically, partial correlation matrices were first estimated from this item set, again controlling for participant age and gender. These matrices were then subjected to cluster analysis, specifying the extraction of 20 clusters. The estimated correlations between items served as the distance metric within the analysis after first converting the correlations to a distance metric, via $d_{XY} = 1 - r_{XY}$, such that very highly correlated items would be indexed as having smaller distances between them.

Additionally, variables representing reverse-scored versions of all 176 items (i.e., $X_r = -X$) were included in the analysis. Within cluster analysis, this allows negatively correlated items – such as antonyms or negations of the same content – to be placed as members of the same cluster. A HCA conducted in this manner will result in a dendrogram containing two symmetrical halves, consequently the second half can be ignored as it consisting entirely of the oppositely-scored items from the first half (Wood et al., 2010). All code used to run these analyses in R can be found at https://osf.io/j6rgq/?view_only=46ecd7ff281347f099148e630fe39ee1.

It may be more common to employ factor analysis rather than cluster analysis to identify multiple distinctions within a larger set of items found to be correlated with outcomes of interest (e.g., Arumäe et al., 2022). Cluster analysis was employed rather than factor analysis for several reasons. First, cluster analysis will tend to place items on the same cluster when they cross a particular threshold of association with one another. In contrast, factor analysis aims to maximally explain the observed correlation or covariance matrix. This difference becomes important when there are items that are very distinct from nearly every other item in the set. Cluster analysis will tend to place such items as separate clusters, whereas factor analysis will tend to have such items load negligibly on all extracted factors and essentially be excluded from the analysis. Similarly, factor analysis may tend to split larger groups of inter-correlated items into smaller ones rather than identifying an item-group from one or more items that are largely distinct within the item pool. Cluster analysis will thus tend to assign greater representation to 'rare' or 'infrequent' content than factor analysis. For these reasons cluster analysis was regarded as more compatible with the *discovery* purposes of the present analysis.

## 3. Results

### 3.1. Relationships between UDBs

The relationships between the four behaviors when controlling for age and gender are shown in Table 1. All associations were positive, consistent with the general understanding that people who engage in one UDB are more likely to engage in others. Only the relationship between *driving after drinking alcohol* and *eating/drinking while driving* failed to reach statistical significance ($r = 0.07, p = 0.06$). However, all correlations were no larger than $r = 0.23$ in magnitude, indicating that the four UDBs examined here were nonetheless relatively distinct.

### 3.2. Themes of personality associations with UDBs

Table 2 provides a label for each of the 20 clusters selected by examining common themes in the items assigned to each cluster, and further provides the item which showed the largest absolute loading on each of the 20 clusters when the items were regarded together as a scale. Supplemental Table S1 shows the associations between all 176 items and the four UDBs. The clusters are ordered within Table 2 (a) first to show clusters with non-trivial ($|r| \geq 0.10$) associations with all four driving behaviors; (b) then to show clusters relating most highly to a particular UDB (although notably, no clusters were most highly associated with *eating/drinking while driving*); and finally (c) to highlight clusters of items relating to different UDBs in opposite directions – for instance, predicting *more* speeding but *less* driving while unbelted or intoxicated. These final clusters can be particularly useful for indicating the psychological forces that distinguish the measured UDBs from one another (Wood et al., 2015).

#### 3.2.1. Clusters associated with all four UDBs

Individuals who more highly endorsed items concerning tendencies toward *accepting cheating, resisting rules and authority,* and *excessive talkativeness* (e.g., "talk even when I know I shouldn't") were more likely to do all four UDBs examined here.

#### 3.2.2. Clusters most associated with speeding

Clusters which showed their largest association with speeding included *deriving greater pleasure from 'high-risk' activities* (such as bungee jumping or whitewater rafting), *preferring reckless or spontaneous activities*, and *having a 'take charge' personality* – which concerned in part feeling above-average and talented. These clusters were all positively associated with speeding, and also showed smaller but statistically significant positive associations with the tendency to drive after drinking alcohol.

The two remaining clusters showing their largest associations with speeding were somewhat harder to characterize given the heterogeneous content and low intercorrelations between items (average inter-item correlations, $r_{kk'} < 0.10$). However, items

**Table 2**
Summary of Relationships between IPIP Clusters and Unsafe Driving Behaviors (UDBs).

| # | Cluster label | Most Representative Item | $n_K$ | α | $r_{kk'}$ | $M_1$ | SD | Speeding | Unbelted | Alcohol | Eat/drink |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Clusters relating to all four UDBs* | | | | | | | | | | | |
| 1 | Acceptability of cheating | Would never cheat on my taxes. (R) | 9 | .70 | .21 | -.52 | .32 | .19 | .27 | .24 | .11 |
| 2 | Resist rules, authorities | Break rules. | 12 | .85 | .30 | -.37 | .35 | .19 | .20 | .21 | .11 |
| 3 | Impulsive talkativeness | Shoot my mouth off. | 7 | .73 | .29 | -.35 | .40 | .20 | .12 | .11 | .12 |
| *Clusters relating most highly to speeding* | | | | | | | | | | | |
| 4 | Like dangerous, risky activities | Like to do frightening things. | 12 | .86 | .37 | -.33 | .40 | .27 | .09 | .21 | .03 |
| 5 | Engage in risky experiences | Have persuaded others to do something really adventurous or crazy. | 10 | .78 | .26 | -.20 | .33 | .25 | .13 | .21 | .03 |
| 6 | 'Take charge' personality | Act as a leader. | 8 | .77 | .27 | .08 | .36 | .23 | -.01 | .10 | .06 |
| 7 | Enjoy large social events | Would enjoy campaigning for political office. | 6 | .39 | .08 | -.33 | .32 | .22 | .10 | .02 | -.05 |
| 8 | Reckless spending | Don't like to spend money. (R) | 7 | .35 | .09 | -.14 | .31 | .17 | .14 | .07 | .12 |
| *Clusters relating most highly to driving unbelted* | | | | | | | | | | | |
| 9 | Negative view of self & others | Dislike myself. | 18 | .80 | .17 | -.51 | .24 | -.03 | .30 | -.03 | .00 |
| 10 | Unconcerned with others | Use others for my own ends. | 8 | .61 | .17 | -.64 | .25 | .12 | .25 | .11 | .00 |
| 11 | Damaged, self-destructive | Am self-destructive. | 6 | .64 | .23 | -.65 | .30 | .10 | .24 | .14 | .04 |
| 12 | Forgetfulness, messiness | Frequently forget to do things. | 8 | .77 | .27 | -.42 | .35 | .06 | .23 | .00 | .14 |
| *Clusters relating most highly to driving after drinking alcohol* | | | | | | | | | | | |
| 13 | Crude, immodest behavior | Use swear words. | 8 | .74 | .24 | -.15 | .38 | .18 | .07 | .34 | .11 |
| 14 | Like parties, crowds, drinking | Like wild parties. | 9 | .71 | .22 | -.39 | .36 | .24 | .06 | .33 | .02 |
| 15 | Low religious belief | Believe in God. (R) | 16 | .95 | .58 | -.20 | .56 | -.01 | .00 | .24 | .05 |
| 16 | Low religious experience | Have felt contact with a divine power. (R) | 6 | .92 | .66 | .13 | .65 | -.04 | -.06 | .23 | .03 |
| 17 | Charming, flirtatious | Enjoy using my charm. | 5 | .70 | .33 | -.01 | .41 | .13 | .04 | .21 | -.02 |
| *Clusters relating in opposite directions to different UDBs* | | | | | | | | | | | |
| 18 | Reluctant to engage, try things | Prefer to participate fully rather than view life from the sidelines. (R) | 10 | .66 | .16 | -.43 | .24 | -.17 | .16 | .01 | -.01 |
| 19 | Distrust reality or authorities | Feel that people and things around me are not real. | 7 | .62 | .18 | -.47 | .29 | .08 | .20 | .16 | -.11 |
| 20 | Feel weak, easily exhausted | Feel healthy and vibrant most of the time (R) | 4 | .78 | .48 | -.40 | .48 | -.03 | .14 | -.13 | .01 |

**Note.** All Ns between 680 and 748. $n_K$ indicates the number of IPIP items classified into the cluster; α and $r_{kk'}$ indicate the coefficient alpha and average inter-item correlation among items within the cluster, respectively. "(R)" indicates that the item is a negative representation of the overall cluster content summarized by the cluster label, and is reverse-scored when averaging items to estimate the mean and standard deviation (M, SD) of cluster endorsement. A complete list of correlations between the 176 IPIP items and UDBs is contained in the Supplemental Table S1. Positive correlations between clusters and UDBs are shown in blue, negative in red, with larger correlations shown with darker coloration.

indicating *enjoying large social events* (e.g., "Would enjoy campaigning for political office"; "Enjoy elaborate ceremonies"), and *being comfortable spending money* (e.g., "Spend more money than I have") tended to be positively associated with speeding.

### 3.2.3. Clusters most associated with driving unbelted

Tendencies toward being *unconcerned with others* and toward *seeing oneself as damaged or self-destructive* were most associated with driving without a seatbelt, but also showed smaller positive associations with speeding and driving after drinking. Items indicating being *forgetful and messy* also tended to indicate greater tendencies to drive unbelted, but also to eat and drink while driving.

Interestingly, people who described more *negative views of self & others* (e.g., "Dislike myself"; "Distrust others") were much more likely to drive without a seatbelt ($r = 0.30$), but these tendencies were largely unassociated with the other UDBs examined here ($|rs| \leq 0.03$).

### 3.2.4. Clusters most associated with driving after alcohol consumption

Individuals who described themselves as *liking parties, crowds, and drinking*, as *being charming and flirtatious,* and as *using crude/harsh language* were considerably more likely to drive after drinking alcohol, and were also somewhat more likely to speed. Note that the cluster concerning liking parties also contained two items directly concerning alcohol consumption: "Often drink too much" and "Rarely get drunk," which indicate this cluster was associated with driving after drinking in part due to greater tendencies to drink alcohol more generally.

Individuals who described greater *religious devotion* and as having *religious/spiritual experience* ("Have felt contact with a divine power") were only less likely to drive after consuming alcohol; these religious tendencies were unassociated with the other UDBs examined here ($|rs| \leq 0.06$).

### 3.2.5. Clusters showing associations with UDBs in opposite directions

Three of the UDBs identified here showed significant associations with UDBs in opposite directions.

First, individuals who described themselves as *reluctant to engage with events* (e.g., "keep myself uninvolved" vs. "try out new things") were significantly *more* likely to drive unbelted, but were significantly *less* likely to speed.

Second, individuals who described *distrusting reality and authorities* (e.g., "Feel that people and things around me are not real") were significantly *more* likely to drive unbelted and to drive after consuming alcohol, but were significantly *less* likely to eat and drink while driving.

Third, individuals who described *feeling weak or easily exhausted* (e.g., "Am unable to do some of the things I would like") were significantly *more* likely to drive unbelted, but were significantly *less* likely to drive after consuming alcohol.

### 3.3. Mean endorsement of IPIP items related to risky driving

The characteristics associated with increased levels of the four UDBs examined here were generally *uncommon*, in the sense of being generally unendorsed by most people. As shown in Table 2, the characteristics most regularly associated with UDBs – such as tendencies toward resisting rules, viewing cheating as acceptable, and talking impulsively – generally showed endorsement far below the neutral scale midpoint, meaning that people tended to report these items as "inaccurate" as descriptions of their own characteristics. Only items from two of the clusters associated with increased risky behavior – which concerned having a 'take charge' personality or having little personal religious experience – tended to be endorsed above the scale midpoint, i.e., as being "accurate" for describing their characteristics. Since mean item endorsement is very highly correlated with the item's mean rated social desirability (Rogers & Biesanz, 2015; Wood & Furr, 2016), this indicates that the characteristics associated with UDBs tended to generally be understood as socially undesirable.

## 4. General discussion

### 4.1. Toward a deeper understanding of UDBs

The present investigation aims to better identify the wide range of psychological and behavioral characteristics that may play a role in predicting important UDBs, by correlating a broader range of self-rated personality items with UDBs and placing greater priority on item-level associations. Investigations which largely dispense with multi-item scales and instead present item-level associations with variable of interests may be increasing in prominence, undergirded by the understanding that multi-item scales obscure important associations that may be more identifiable at the item-level (Arumäe et al., 2022; McCrae, 2015; Mõttus et al., 2017, 2019; Stewart et al., 2022; Wood et al., 2015).

Item-level analyses of this sort offer the opportunity to provide a richer picture of the characteristics which may alter a person's likelihood of engaging in UDBs. The next sections will thus involve summarizing themes from the present analyses regarding the possible nature of each of the four UDBs below – with a particular focus on the psychological characteristics differentiating the UDBs from one another. Note that these interpretations regularly involve deeper examination of the 176 items found to relate non-trivially to UDBs, which can be found in Supplemental Table 1.

### 4.1.1. Driving without a seatbelt

The current findings point to the importance of understanding driving unbelted as an *inaction* in a way that the remaining UDBs are

not. This may help make sense of the fact that driving unbelted was associated with feeling easily strained or exhausted (e.g., "Tire out quickly"); meaning some people may come to drive unbelted from a sense buckling up is 'one thing too many' for them to do. The analysis also linked driving unbelted to general forgetfulness and 'mental disorganization', highlighting that drivers may often arrive at driving unbelted as an *unintended mistake* in the way less typical to other UDBs (Suffoletto et al., 2022).

Driving unbelted may also be unique among the four behaviors examined here in that it can be understood as directly increasing injury risk to oneself but not necessarily to other drivers. This may help to account for the strong role for characteristics indicating low self-regard, whether through an internalized sense of low self-worth ("Thought that my life had been a failure"), or a sense that the world is "unreal", or through a more general self-destructiveness. This finding somewhat corroborates findings reported by Loo (1984), which observed positive relationships exist between self-reported seat-belt use and fear of death. Similarly, Caspi et al. (1997). reported that individuals scoring lower on measures of social closeness and harm avoidance tended to score higher on a dangerous driving measure involving driving without a seat belt.

A curious finding was that items that reflected being *unconcerned with others* (e.g., "Use others for my own ends"; "Pretend to be concerned for others") tended to be more associated with driving unbelted than the other UDBs examined here, despite not being a behavior directly affecting others.

### 4.1.2. Driving after drinking alcohol

Driving after drinking is likely among the most negatively viewed UDBs, given public safety campaigns drawing attention to the crash risks this behavior presents to oneself and others, and the severity of punishments for being caught engaging in the behavior (Alonso et al., 2015). Being generally less concerned with hurting others or with conforming to conventional standards of morality (e. g., "Would never indulge in extramarital affairs") could thus help to disinhibit a person to drive drunk.

Respondents reporting lower religious faith and religious experience were considerably more likely to report driving after drinking alcohol. Prior research have indicated that the tendency for religious people to drink less alcohol may be the primary mediator of this association (Patock-Peckham et al., 1998; Stacy et al., 1991), perhaps due to a heightened sense of drinking as indicating a moral defect (Preston, 1969). To examine this possibility, the two clusters related to religiosity were correlated with the IPIP items most directly indicating tendencies to overly consume alcohol: "Rarely get drunk" and "Often drink too much." Both religiosity clusters showed smaller correlations with these items than they did with driving after drinking (all $|rs| < 0.18$ vs. 0.24), indicating that a tendency for religious people to drink less alcohol is unlikely to fully account for their lower tendency to avoid driving after consuming alcohol.

A contribution of the present study is showing that religiosity and religious experience is mainly predictive of less driving after drinking; there were virtually no indications that religiosity was predictive of any of the other UDBs examined here.

### 4.1.3. Speeding

In this study, the characteristics which were most uniquely associated with speeding involved having an *active, 'take charge', or strong* personality. These associations may derive in part from the fact that speeding is likely the most *stimulating* or *exciting* of the UDBs examined here. This finding aligns with past studies that have linked speeding behaviors to sensation-seeking (Delhomme et al., 2012; Jonah et al., 2001; Whissell & Bigelow, 2003; Zhang et al., 2019). These associations may also point to the role of characteristics that increase a person's sense of being able to handle the literally more high-stakes situation of driving faster – where crashes will typically be both more *likely* and more *severe* (Sobhani et al., 2011) – in a safe manner.

### 4.1.4. Consuming food while driving

Although consuming food while driving is regarded as an important UDB by many safety professionals and researchers (e.g., Schroeder et al., 2013; Vegega et al., 2013), the present analyses are consistent with others who regard this behavior as "somewhat more benign in terms of risk" (Dingus et al., 2016, p. 2640). In this investigation, consuming food or drink while driving was clearly the least associated with self-reported personality items in any manner. As case in point: whereas the three other UDBs examined here were each correlated above a $|r| > 0.15$ level with at least 47 IPIP items, the item "Ate or drank while driving" was only associated with *one* item above this magnitude (see Supplementary Table S1). This in turn indicates that people do not tend to understand *eating food while driving* as being as *risky, exciting, illegal,* or *immoral* as other UDBs, which in turn prevents traits involving the person's level of pursuit or concern for such effects from being associated with the behavior.

## 5. Limitations and future directions

### 5.1.1. Constraints on generality

Although the IPIP as assessed within the ESCS offers one of the best opportunities for exploring how the individual differences in behavioral and psychological characteristics may be associated with UDBs (or any other behavior) *en toto*, there are ways in which it departs from the ideal study. While the ESCS sample may especially represent an impressive diversity of age groups, future research will need to examine the extent to which associations documented here generalize to samples varying more in their ethnicity and geographic diversity.

Additionally, the self-reported driving behaviors were rated in 1997; as cell phones were not yet widely owned at this time, texting and talking on the phone while driving were not yet common UDBs. Consequently, beyond the more general need to replicate the associations observed here in new samples to demonstrate their generality and robustness, it will be important to demonstrate that the associations between self-reported traits and UDBs documented here are not merely historical.

### 5.1.2. More contemporaneous measurement of personality and UDBs

Another important limitation of the study is that the IPIP items were rated by participants over a 13-year period, with many IPIP items being rated as far as four years prior or nine years after rating their frequency of engaging in the UDBs. Many of the correlations between the IPIP and UDBs are likely to underestimate the associations they would have shown in a cross-sectional survey, as items can generally be expected to correlate more highly with one another when they are assessed close together in time.

As noted earlier, a number of widely-used scales in transportation safety research already contain items measuring several of the UDBs regarded as most important to – such as speeding, texting and talking on a phone while driving, tailgating, and driving drunk – but sum or average these together into a broader scale score (Dula & Ballard, 2003; Harris et al., 2014; Houston & Harris, 2003; Scott-Parker et al., 2012). Consequently, an opportunity to identify characteristics showing varying relationships with different UDBs with scales measured more contemporaneously will be to simply analyze previously collected data connecting personality traits to these scales at a more molecular level of analysis (Mõttus, 2016; Wood et al., 2015).

### 5.1.3. Surveying additional UDBs

Although the present study examined personality correlates of some of the most consequential UDBs, many others regarded as priorities for research and safety interventions could not be examined because they were not rated within the ESCS sample. Future research could include a considerably greater range of UDBs – such as texting or talking on the phone while driving, making unsafe or illegal driving maneuvers such as running red lights, 'tailgating' others, making illegal U-turns, or fast acceleration or breaking. It is also important to note that while the present study analyzed the correlates of self-reported frequency of having "drove a car after having a few alcoholic drinks", which we have referred to as *driving after drinking,* these will differ somewhat from the correlates of *drunk driving,* which is a more severe UDB to report engaging in and as such should be expected to have somewhat more negative psychological predictors. It will be important to measure this UDB through more direct indicators in future research. In addition to more direct self-report items, this would ideally include more directly observed records of UDBs – such as more objective records of speeding behavior that are sometimes passively recorded through phone apps or a vehicle's electronics systems (e.g., Richard et al., 2013). This would also help to address concerns that correlations between items could be accounted for in part by common method biases, such as socially desirable or acquiescent responding.

A key conclusion of the present analysis is that while many of the personality characteristics that commonly promote specific UDBs will promote others, each UDB is likely to show a somewhat distinct profile of characteristics. For instance, texting or talking on the phone while driving is thought to often be motivated by more *social* reasons than most other UDBs – such as to help to keep connected or maintain smooth communication with friends (Benson et al., 2015; Foreman et al., 2021; Seiler, 2015). This may lead to the hypothesis that traits associated with the greater pursuit of these goals will show greater associations making calls and texting while driving than they show with other UDBs.

### 5.1.4. Representing the reasons for associations between psychological characteristics and UDBs

The present study does not address the question of *why* different traits are associated with speeding or driving after drinking, and these associations can take many forms. As an example, religiosity is likely associated with a lower tendency to drive after drinking in part because it is associated with less drinking; however additional analyses suggested this is unlikely to fully explain the association. This association could additionally involve more religious individuals showing greater tendencies to avoid driving after already being inebriated. Similarly, people with tendencies toward more impulsive action (e.g., impulsive talkativeness or reckless spending in the present study) could be more likely to speed while driving because they view speeding as more *stimulating* than most drivers, or show heightened *preference* for stimulating activities, in addition to many other possible reasons (e.g., seeing less risk of injury from a crash, or having lower concern for such risks).

The item-level associations identified here appear generally consistent with a broader understanding that traits will be associated with behaviors in instances where the normatively expected effects of the behavior match the outcomes that people high on the trait more highly pursue or avoid (e.g., DeYoung, 2015; Read & Miller, 2022; Tett et al., 2013). For instance, speeding, driving after drinking, and driving without a seatbelt are likely to be broadly understood as illegal actions, and many of the items that predict lower engagement with these UDBs concern heightened concern with acting legally (e.g., "Would never cheat on my taxes."; "Try to follow the rules."). The reason that eating or drinking while driving showed smaller associations with these items can be understood as arising in part from the fact that this behavior is not as widely understood as *illegal* in this manner.

A valuable area of future research would be to represent such reasoning formally and empirically. This can be done by having respondents describe their own understanding of the expected effects of engaging in specific UDBs, and then testing whether individual differences in the *expected effects* of these behaviors versus the *valuation* of these effects helps to mediate the larger association between the psychological characteristic and UDBs (Wood et al., 2022; Le et al., 2024; Wood et al., 2024).

Ultimately, better identifying the specific processes that account for these associations can be useful for creating better interventions or countermeasures. The present findings should help improve the prediction of which individuals will be most likely to engage in specific UDBs. This information can in turn be used in several ways, such as to adjust insurance premiums, or to direct interventions toward people most likely to engage in UDBs – in addition to informing how these interventions can be structured to be more effective (Matz et al., 2017).

## 6. Conclusion

The present study aimed to uncover a greater range of self-reported psychological and behavioral characteristics associated with UDBs, with a special focus on identifying characteristics that were predictive of one UDB but not others. By linking the 2539-item IPIP (Goldberg et al., 2006) to four distinct UDBs, a broad range of such characteristics were identified, indicating several distinct psychological pathways to a driver's decision to speed, drive drunk, or drive unbelted. Some psychological characteristics were found to be associated with several distinct UDBs – such as tendencies to resist rules, view cheating as acceptable, or to talk impulsively. However, other characteristics were found to be associated with a single UDB – for instance, religiosity was solely predictive of lower driving after drinking but not of lower speeding or unbelted driving, and negative attitudes toward oneself (e.g., "dislike myself") was strongly predictive of driving without a seatbelt but not other UDBs. Indeed, several psychological and behavioral characteristics were identified that were predictive of higher rates of one UCB but lower rates of another – for instance, people who described feeling more easily tired or exhausted were more likely to drive without a seatbelt but less likely to drive drunk, and people that were more willing to try new things were less likely to drive without a seatbelt but more likely to speed. This serves to provide more granular detail to our understanding of the characteristics that lead people to engage in behaviors that put themselves and others at risk on the road, which ultimately will be useful for predicting who is likely to engage in these behaviors and why.

### CRediT authorship contribution statement

**Dustin Wood:** Writing – review & editing, Writing – original draft, Validation, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **P.D. Harms:** Writing – review & editing, Writing – original draft, Conceptualization. **Emmanuel Kofi Adanu:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Conceptualization.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.trf.2024.10.024.

### Data availability

I have shared a link which cna be used to rerun all analyses within the manuscript.

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