

BIOLOGICAL AND PSYCHOBEBHAVIORAL CORRELATES OF CREDIT SCORES AND AUTOMOBILE INSURANCE LOSSES: TOWARD AN EXPLICATION OF WHY CREDIT SCORING WORKS

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ABSTRACT

The most important new development in the past two decades in the personal lines of insurance may well be the use of an individual's credit history as a classification and rating variable to predict losses. However, in spite of its obvious success as an underwriting tool, and the clear actuarial substantiation of a strong association between credit score and insured losses over multiple methods and multiple studies, the use of credit scoring is under attack because there is not an understanding of *why* there is an association. Through a detailed literature review concerning the biological, psychological, and behavioral attributes of risky automobile drivers and insured losses, and a similar review of the biological, psychological, and behavioral attributes of financial risk takers, we delineate that basic chemical and psychobehavioral characteristics (e.g., a sensation-seeking personality type) are common to individuals exhibiting both higher insured automobile loss costs and poorer credit scores, and thus provide a connection which can be used to understand why credit scoring works. Credit scoring can give information distinct from standard actuarial variables concerning an individual's biopsychological makeup, which then yields useful underwriting information about how they will react in creating risk of insured automobile losses.

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"... a man drives as he lives."

Tillman and Hobbs, 1949, p. 329

"If serotonin is the brakes, dopamine is the accelerator in the drive to risky behavior." Zuckerman and Kuhlman, 2000, p. 1021

"A drug given to Parkinson's patients may have an unexpected side-effect—compulsive gambling, U.S. researchers say. An unusually large number of patients taking pramipexole [a dopamine agonist] gambled themselves into debt, while patients taking other drugs did not, the team at the Muhammad Ali Parkinson Research Centre in Phoenix, Arizona, reported."

Reuters, April 13, 2003

INTRODUCTION AND BACKGROUND

Perhaps the most important new development in the past two decades in insurance is use of a person's credit history to predict losses. To this end, a formula is constructed using approximately 10–50 of more than 450 variables obtainable from an individual's credit file to derive a summary numerical score for predicting insurance losses (as opposed, e.g., to banks using credit records to predict default (credit risk) or its use in commercial insurance). The positive statistical relationship between credit scores¹ and insured losses has been verified by multiple studies and multiple methods, and no study reporting a lack of statistical relationship has been published in the refereed literature. In automobile insurance, for example, Miller and Smith (2003) found that of six possible automobile coverages, credit scores are always in the top three most important loss predicting variables, and often the most important variable. Credit score is the first variable considered in personal injury protection and medical payments coverage, second in bodily injury and property damage coverage (behind age and gender), and third in comprehensive and collision coverage (age and gender being second, with make and model of the car dictating costs more).

Credit history has, in fact, been used for decades in commercial lines of insurance and life insurance. Although it has been known since at least 1949 that credit history is related to driving accidents, the advent of high capacity, high-speed computers has made massive personal credit files available, and has made it feasible to routinely use this credit information for predicting insurance losses in personal lines of property and casualty insurance. Tillman and Hobbs (1949) show that drivers with bad credit history have repeated crashes at a rate six times higher than those with good credit history. Moreover, a 1968 study of Washington state drivers (Insurance Institute for Highway Safety, 2003) showed that within the group of drivers who had a history of no automobile accidents, 64 percent had good credit while 35 percent had bad credit.

¹ Some authors use the terminology "insurance score" for the credit history-based quantity used to predict insured losses and reserve the term "credit score" for the value obtained to predict creditworthiness for credit cards, mortgages, etc. However, popular and public policy discussions on the use of credit history to construct a "score" for predicting insured losses use the term "credit score" for this number, and hence the terminology "credit score" will be used here.

On the other hand, among drivers who had two or more automobile accidents, 35 percent had bad credit while only three percent had good credit. Tillman and Hobbs (1949), who examined other lifestyle variables in addition to credit scores, put it quite succinctly: "... a man drives as he lives." (p. 329).

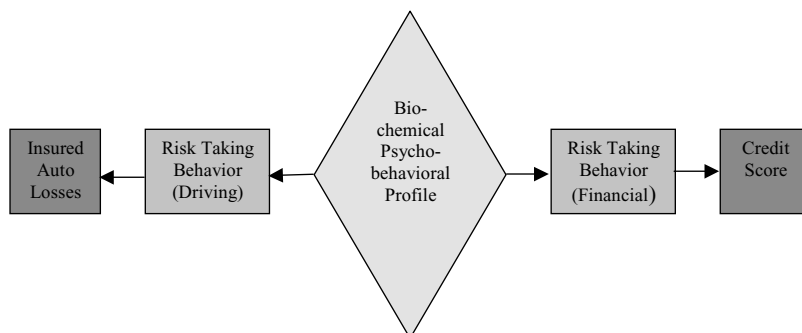
In spite of the success of credit scores as an underwriting tool and the clear and consistent demonstration of their association with losses, cross validated over multiple methods and multiple studies (c.f., Monaghan, 2000; Kellison et al., 2003; Miller and Smith, 2003; Wu and Guszcza, 2003), the use of credit scoring remains controversial and under attack. One reason for this controversy is that it is not clear *why* there is a correlation between credit score and insured losses (unlike the use of driving history to predict losses, building construction type to predict homeowners insurance losses, etc.). As we shall show, the explication of why this relationship exists may lie below the surface in the fundamentals of human biology, psychology, and behavior.

A problem confronting the insurance industry is exhibiting to the legislatures (and the public) that there is an underlying rationale for the observed relationship between credit scores and insured losses; that it is not a statistical fluke. In this article, we present a detailed review of the literatures on biological, psychological, and behavioral characteristics of individual risk taking and note how those same characteristics affect both financial decision making and risky driving habits. A possible explanation of the observed relationship between credit scores and insured losses is that credit scores yield new information about the biochemical and psychobehavioral characteristics of the individual, which is then predictive of their insurance loss propensity. Haner (1968) began addressing this issue when he successfully studied using psychological tests as a single unitary underwriting variable in automobile insurance. The use of credit scores broadens this line of investigation.

Figure 1 provides a very simplified graphical view of this relationship: Credit scores yield (imperfect) information concerning an individual's financial risk taking decision making behavior and hence also their psychological profile (which can also be generally related to their biochemical makeup). This same information (biological and psychological) in turn provides information concerning the individual's decision making and risk taking behavior associated with driving an automobile, and their

FIGURE 1

Simplified Model of Conjunctive Influences between Insured Losses and Credit Score



psychological characteristics related to accident propensity and claim filing behavior. The central nexus for both automobile losses and credit scores provided by various common biological and psychobehavioral factors provides a link between driving responsibility and financial responsibility. These connections will be made specific and detailed in the sequel (and summarized in part in Figure 4).

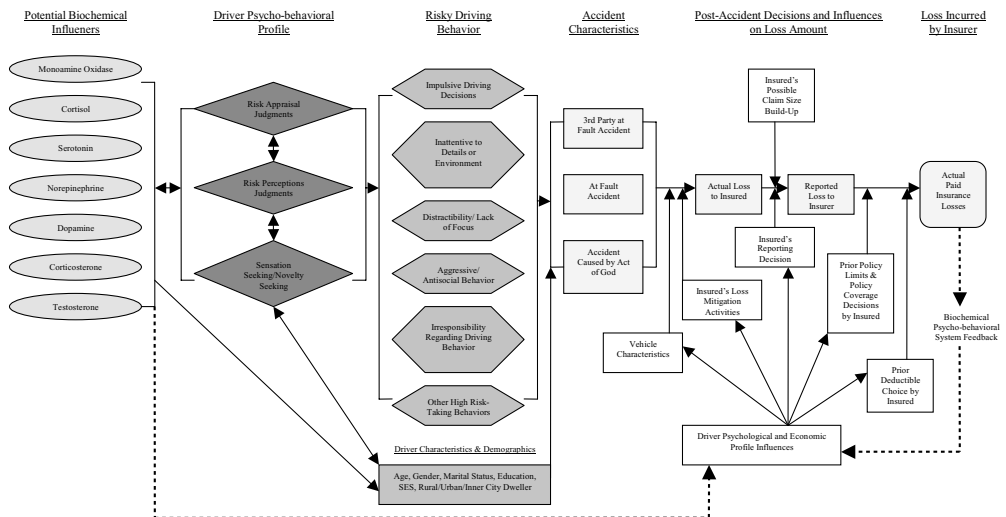
Simply put, there are certain overarching biochemical and psychobehavioral components to risk taking attitudes and behavior that transcend the particular arena in which risk taking attitudes/perceptions and reactions play out (driving or financial). Of course, acts of God, truly random accidents, or economic and medical exigencies may also be involved in determining any one individual's actual observed losses and credit scores at a particular time, but how one reacts to these (or prepares for these) is also influenced by one's psychological and biological factors. The correlation between credit scores and insured losses perseveres even after the effects of traditional classification variables such as age, gender, marital status, driving location, etc. are factored out (c.f., Kellison et al., 2003; Miller and Smith, 2003; Wu and Guszcza, 2003). Thus, credit scores must be tapping a fundamental new and distinct aspect of individual behavior related to risk assessment, which we postulate is biopsychobehavioral. Credit scoring "works" because it provides a numerical proxy for the biopsychobehavioral makeup of the individual which affects insurance losses. It yields additional information about one's responsibility and stability, stress level, and distractibility, all of which influence the amount of insured losses paid by the insurance company.

The article proceeds as follows. In the next section we shall outline some biological and psychobehavioral aspects of risky driving. Then we investigate the biological and psychobehavioral characteristics which have been found to be associated with risky financial decision making, including credit effects. Particular personality types (sensation/novelty seeking and Type A personality) stand in common to both financial and automobile driving behavior, and are of sufficient importance in both realms that we investigate these types further by delving into biochemical aspects of sensation seeking in a subsequent article (Brockett and Golden, 2007). This provides an explanation of why decision making behavior in seemingly different parts of one's life is related.

RISKY DRIVING AND BIOPSYCHOBEHAVIORAL COMPONENTS OF INSURED AUTOMOBILE LOSSES

The relationship between psychobehavioral characteristics and risky driving characteristics has been known since at least the 1940s. Tillman and Hobbs (1949), in their study of taxi drivers, determined that personality characteristics and social background are related to accident rates of the individual. High-accident taxi drivers shared certain life history characteristics (instability, disrespect for organized authority, school-related problems, juvenile criminal behavior, short-term adult employment, often fired by employer, police record, antisocial behavior, credit problems). Driving behaviors included aggressiveness, impulsiveness, disregard for others, and disrespect toward authority. These behaviors mirrored the behaviors found in a group of high-accident individuals from the general population (c.f., Grey, Triggs, and Haworth, 1989, p. 52).

Many factors work together to impact the size of incurred losses by the insured, which are ultimately paid by the insurer. These range from biochemical factors to

FIGURE 2**Comprehensive Overview of Biochemical and Psychobehavioral Influences Related to Paid Automobile Insurances Losses**

psychobehavioral individual characteristics, to environmental influences, and decision making. Figure 2 presents a representation of factors distilled from the literature that combine to influence the size of the ultimate paid loss.²

This section of the article will describe certain elements of Figure 2 in depth with the associated research; however, one should remain mindful of the “chicken and egg” gestalt. Biochemical influencers impact the driver’s psychobehavioral profile which, in turn, can result in risky driving behavior. Driving behavior is related to accident characteristics, and post-accident decisions will determine, in part, the actual paid losses incurred by the insurer.

There is a large body of literature that studies the relationships between risky driving and the psychological profile known as “sensation seeking.”³ For example, Iversen and Rundmo (2002) found sensation seeking to be the strongest predictor for risky driving as compared to anger and normlessness, whereas risky driving was the strongest predictor for involvement in accidents. Ulleberg and Rundmo (2002)

² Attribution concerning the directionality of the flows between factors (arrows in the figure) has a bit of a “chicken and the egg” gestalt to it, as factors may circularly impact each other. Biochemical influencers, for example, may impact demographic characteristics such as where to live, level of education achieved, job stability, etc. and demographics impact biochemical levels (e.g., testosterone in teenage boys, environmentally increased stress increasing cortisol levels, etc.).

³ The “Type A personality” profile is also connected to insured losses (c.f., Carrere et al., 1991; Stokols et al., 1978; Synodinos and Papacostas, 1985). Type A personality has been related to stress levels in driving and to aggression (e.g., Keltikangas-Järvinen and Raikkinen, 1993). Goldstein and Mosel, 1958 have shown that aggression is related to accidents and traffic violations (c.f., Naltanen and Summala, 1976; Sivak, 1983 for a review). This personality type is also related to adverse financial decision making (Carducci and Wong, 1998).

determined that personality traits, such as anxiety, normlessness, sensation seeking, and aggression, strongly correlate with risk perception and risky driving behaviors as they influence attitudes toward traffic safety. Affinity toward sensation seeking and the inability to control driving behavior has been shown to be related to high-risk driving by Heino, Molen, and Wilde (1992), McKenna (1982), Naltanen and Summala (1976), Summala (1987), and Zuckerman and Neeb (1980).

Zuckerman (1979) defines sensation seeking as "the need for varied, novel, and complex sensations and experience and the willingness to take physical and social risks for the sake of such experience" (Zuckerman, 1979, p. 10). Zuckerman's "sensation seeking" is closely related to Cloninger's (1987) personality trait of "novelty seeking." In fact, the two terms are often used interchangeably. Both Zuckerman and Cloninger regard sensation/novelty seeking as a fundamental dimension of temperament with strong relationships to antisocial behavior.

The Appendix contains a detailed literature review of the empirical research on driving risk behavior identified and summarized in Table 1. This table includes the findings of the research on psychobehavioral and biochemical characteristics of sensation seeking as they relate to driving behaviors. A more detailed discussion of some of these articles follows.

Jonah (1997), in a large-scale review of such studies, ascertained that 36 of 40 studies found a positive relationship between sensation seeking and one or more aspects of risky driving. Common findings included high sensation seekers perceive less risk in driving, perceived risk and risky driving are negatively correlated, and high sensation seekers may initially perceive driving behaviors as risky, but are willing to accept the risk. However, when a risky driving behavior results in no accident, the perceived risk is lowered and the behavior reinforced.

Personality and driver behavior have been studied from many and sometimes, opposing, theoretical constructs. These theories of personality provide frameworks within which behavior and personality types can be discussed and related to accident frequency.⁴ A brief review of some of these theories follows:

- *Problem Behavior Theory* correlates risky driving with other problem behaviors (i.e., drinking, smoking, drug use, etc.) and personality factors (i.e., thrill seeking, aggression, responsibility, etc.). These problem behaviors depart from the legal and social norms of society and serve to enhance the individual's sense of self-importance, to impress peers, to establish independence, etc. West, Elander, and French (1993) found that self-interest at the expense of others is related to increased traffic accident risk and is partially mediated by faster driving.
- *The Zero Risk Theory* (Summala, 1988) suggests that drivers control risk by maintaining safety margins around themselves to avoid accidents.
- *Risk Homeostasis Theory* (Burns and Wilde, 1995; Wilde, 2002) recognizes that all behaviors hold some level of risk and the challenge of driving is to maximize the overall benefits of the behavior. The driver learns to adjust behaviors when

⁴ Rothengatter (2002) suggests that none of these theories are precise enough to *prevent* accidents.

a discrepancy is observed between the observed level of risk and the target level of risk.

- *Target Risk Theory* is an adaptation of risk homeostasis and necessitates the adjustment of driving behavior so that perceived risk is in line with target risk (Wilde, 1994). Each driver has a target "acceptable" level of risk which they are willing to live with. Decreased risk due to airbags, for example, can lead to driving faster, increasing the target level of risk.
- *Terror Management Theory* assumes future anticipation and self-reflection leading to awareness of one's own mortality which could be manifested in anxiety and terror. Enhanced self-esteem serves as a buffer to the anxiety and terror; therefore, mortality salience should lead individuals to engage in activities aimed at maintaining or enhancing positive self-esteem. However, individuals who view driving as relevant to their self-esteem are more likely to engage in risky driving (Taubman Ben-Ari, Florian, and Mikulincer, 1999).

Risk takers exhibit a variety of personality characteristics which are related to the biochemical and psychobehavioral attributes described in Figure 2. These personality characteristics are evident in the risk takers' driving habits. Studies on Type A personalities, individuals with a chronic sense of time urgency and impatience, provide useful examples. Subjects in Perry's 1986 study who scored high on the Type A personality scale tended to be more impatient, reported being involved in more accidents and receiving more tickets than those scoring low on the Type A scale. Similarly, drivers in the Miles and Johnson (2003) study who exhibited Type A personality characteristics were more prone to displaying aggressive driving attitudes and behaviors and committing aggressive driving acts. Even though they had more driving citations, they did not self-report lower driving skills. Tsuang, Boor, and Fleming (1985) described individuals with high frequencies of traffic accidents as hostile, angry, intolerant of tension, belligerent, nonconformist, and risk takers. Lajunen and Summala (1995), Carrere et al. (1991), Stokols et al. (1978), Synodinos and Papacostas (1985) all relate the Type A personality to driving behavior, driving accidents, and hence to claims.

Donovan, Umlauf, and Salzberg (1988) describe one group of high-risk drivers as those characterized by impulsivity, sensation seeking, aggression, and antisocial behavior. Subsequent studies identified many predictors of risky driving behaviors for those in this group. Matthews, Dorn, and Glendon (1991) found that general driver stress positively correlated with minor accident involvement. Frequency of daily aggravations, aggression, and stress was associated with poorer self-rated attention and stressed mood states.⁵

Young drivers take greater risks with greater consistency than older drivers (Jonah and Dawson, 1987; Arnett, Offer, and Fine, 1997). Risky driving behaviors, such as speeding, racing, illegal passing, and drinking are related to sensation seeking and

⁵ This may also assist in understanding why stressful bad credit history and overdue bills, job instability, etc. may relate to increased accident frequency. Even events that are seemingly unconnected with driving may substantially increase stress levels (e.g., losing one's job, medical exigencies, death of a loved one, etc.) and this can change one's biochemistry, decrease attentiveness, and increase accident frequency.

aggressive tendencies (Arnett, Offer, and Fine, 1997). Young drivers perceive themselves as less cautious than older drivers; they are at greater risk of injury due to traffic accidents, they perceive less danger in driving situations, and their self-rated level of cautiousness and danger perception is a significant predictor of their risky driving habits (Jonah and Dawson, 1987). Parsons, Siegel, and Cousins (1997) determined that perceived benefits are more predictive of risky driving behaviors and behavioral intentions than the perceived risks. Wilson and Jonah (1988) found that prediction of driving risk in youth can be extended to adults.

Peck (1985) points out that "risk perception and risk choice implicitly involve an attitude or sense of personal vulnerability and . . . recognition of vulnerability may be the single most important mechanism underlying risk taking . . . Unless one has a sufficient sense, cognitively and affectively, of being vulnerable to catastrophic events, there is little motivation to drive cautiously and defensively." (Peck, 1985, p. 60). Jonah (1986) found young drivers at greater risk of being involved in a casualty accident than older drivers, which is a function of their propensity to take risks while driving. Young male drivers, at least in part, are involved disproportionately in accidents because they fail to perceive specific driving situations as being as risky as older drivers perceive them. Young drivers recognize the risk involved in certain specific driving situations, but perceive themselves at less risk than others (Finn and Bragg, 1986).

Aggressive driving behaviors are also associated with situational variables and individual characteristics (Shinar and Compton, 2004). Younger drivers and men are more likely than women to commit aggressive driving behaviors and the differences in the behaviors increase as the severity of the driving actions increases. A strong linear association was found between congestion (number of drivers on the road) and the frequency of aggressive behaviors with aggressive behaviors increasing during rush hour.

Drinking and driving is a risky behavior engaged in by predominantly young males, which is also related to other risky behaviors. Individuals who are most likely to drink and drive are also likely to have problem behaviors (skipping class, fighting), excessive drinking habits, sensation seeking behaviors (driving fast, racing cars, taking chances), and antisocial/aggressive behaviors (Lastovicka et al., 1987). Young drinking drivers are less likely to use seat belts (16.5 percent as compared to the national norm of 68 percent), more likely to use at least one tobacco product (84 percent as compared to the national norm of 47 percent), and more likely to use marijuana (58 percent as compared to the national norm of 24 percent) (Sommers et al., 2000).

Drunk driving is also significantly related to the psychological characteristics of sensation seeking, thrill and adventure seeking, lack of inhibition, boredom susceptibility, and egocentrism. This suggests that drunk driving may be motivated by a propensity for sensation seeking (Arnett, 1990). Drug use and delinquent behavior are also related to drinking/driving, which suggests an underlying syndrome of problem behavior including hostility/aggression, risk taking, and unconventionality (Donovan, 1993). McMillen et al. (1992) found that young drivers under the influence had significantly greater alcohol consumption, greater frequency of driving after drinking and driving impaired, more traffic violations and accidents, and higher self-rating of risk taking after drinking in comparison with other groups. Those individuals apprehended for driving under the influence as a result of an accident or moving violation

scored higher in sensation seeking, hostility, drinking habits/behaviors, and traffic violations/accidents.

Donovan, Umlauf, and Salzberg (1988) describe a second group of high-risk drivers as those characterized by high levels of depression, emotional distress, resentment, and an external perception of control. Garrity and Demick (2001) found negative relationships between cautiousness while driving and depression-dejection, anger-hostility, fatigue-inertia, and tension-anxiety whereas vigor-activity was positively related to cautiousness while driving.

Farrow (1985) correlated traffic violations and citations for young drivers with increases in risky driving behavior, alcohol and drug use, and poor academic performance. Males, at higher risk than females, reported using the car as a means of relieving anxiety and conflict. Parker et al. (1992) found young male drivers to be less concerned about, or less aware of, negative outcomes of traffic violations. They reported finding it more difficult to refrain from committing traffic violations than older drivers and female drivers. Peck (1985) notes that high-accident drivers self-reported socially deviant activities, poor personal relationships, more convictions for traffic violations, high number of miles driven, and more emotional reasons for driving.

Lifestyle characteristics strongly impact accident risk. Gregersen and Berg (1994) found a high probability of a relationship between lifestyle (including alcohol use/abuse, driving habits and behaviors, sociability, sexual involvement, etc.) and accident risks in traffic. Showing off, impressing others, sensation seeking and competition with others increased driving risk. Chliaoutakis, Darviri, and Demakakos (1999) found similar relationships between lifestyle and road traffic accidents, with the additional conclusion that lack of destination is related to high accident risk. Turner and McClure (2004) found that accident involvement increased eight times for drivers with high risk acceptance and doubled for drivers with high driver aggression. Vavrik (1997) identified high-risk drivers as individuals with two or more at-fault accidents in two years and who scored higher on affiliation, desirability, dominance, self-esteem, and exhibition than low-risk drivers, those who had no accidents in two years.

Studies have found that risky drivers share many common demographics, with age and gender being the most common (Peck, 1985; Furnham and Saipé, 1993; Turner and McClure, 2003; Whissell and Bigelow, 2003). Generally, young male drivers are more likely to engage in risky driving behaviors than females or older drivers. Furnham and Saipé (1993) found the number of years driving correlated with convictions for speeding or reckless driving more than with driving accidents. Aggression was significantly related to extraversion, and lawbreaking was significantly related to thrill seeking and boredom susceptibility. Turner and McClure (2003) found gender and age significantly related to driver aggression and high risk acceptance, which increases the probability of involvement in a driving accident. Whissell and Bigelow (2003) established that accidents were a function of gender, age, and recent accident history. Males scored higher on the Speeding Attitude Scale (SAS) and had more speeding tickets. They found that sensation seeking may occur within the context of driving but not other contexts, which would explain the significant correlation between the SAS and speeding tickets but not between the Zuckerman Sensation Seeking Scale-V (SSS-V) and speeding tickets.

In summary, various characteristics of sensation seeking personality types influence driving behavior and involvement in driving accidents.

- High-accident drivers reflect aggressive, impulsive behaviors, disregard for others, and disrespect for authority; they take more risks while driving and are more likely to participate in socially deviant behaviors, have poor personal relationships, drive for emotional reasons, and have more speeding convictions and traffic violations.
- Individuals with high frequencies of traffic accidents are often hostile, angry, intolerant of tension, and under stress.
- Young drivers perceive less danger in driving situations and take greater risks than older drivers; risk perception is correlated with anxiety, sensation seeking, and aggression.
- Drivers with high risk acceptance are more likely to be involved in accidents. Responsible drivers are less risky.
- Individuals who drink and drive are likely to exhibit other problem behaviors and antisocial/aggressive behaviors.

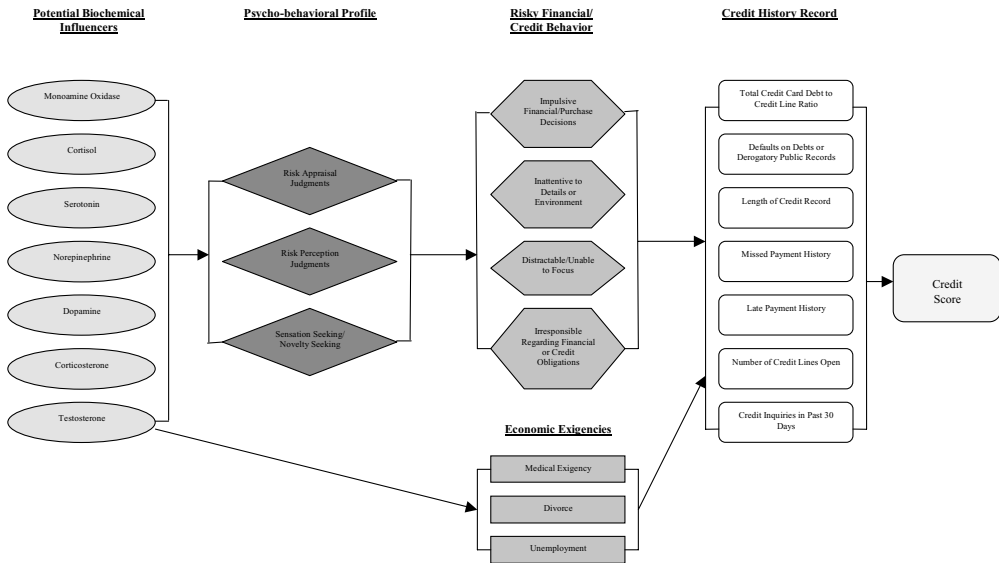
We will now see how some similar characteristics affect the financial habits of the sensation seeking individual. It should be noted that empirical research relating biological and psychological characteristics of individuals to financial habits is much more limited, which offers additional opportunities for future research. The proposed connection between biochemical factors, psychobehavioral factors, and financial risk taking is illustrated through accompanying figures as noted.

FINANCIAL RISK TAKING AND FINANCIAL DISTRESS

Many factors coalesce to impact an individual's financial decisions and, ultimately, their credit history. Lifestyle characteristics and demographics strongly impact accident risk (Gregersen and Berg, 1994; Chliaoutakis, Darviri, and Demakakos, 1999; Turner and McClure, 2004; Vavrik, 1997; Peck, 1985; and Furnham and Saipé, 1993) and also affect credit history. Factors affecting one's credit history can flow from biochemical factors to psychobehavioral factors to economic exigencies and risky financial/credit behavior. Moreover, these individual factors affecting credit and financial decision making are not strictly related to income. Freddie Mac (1999) reports that credit problems occur across all income groups, and individuals with bad credit reports have less knowledge about financial management. Thus credit problems involve more than just income deficiencies. For example, sensation seeking and Type A personality types have consistently been linked to risk taking in financial decision making (Zuckerman, 1983; Zuckerman and Kuhlman, 1978; Harlow and Brown, 1990a, 1990b; Wong and Carducci, 1991; Carducci and Wong, 1998) and, as noted previously, are also related to insured loss generation in insurance.

Figure 3 presents a representation of some of the factors that can ultimately lead to an individual's credit score. Table 2 in the Appendix, "Financial Risk Behavior Research," summarizes the empirical research that was identified on psychobehavioral and biochemical characteristics of financial decision making.

Investigating economic decision making from a biochemical and psychological perspective, Harlow and Brown (1990a, 1990b) conducted a series of experiments on individuals related to risky economic decisions. They then had these individuals complete

FIGURE 3**Comprehensive Overview of Biochemical and Psychobehavioral Influences Related to Credit Score**

the Zuckerman SSS-V, and drew blood to obtain measures of catecholamine activity. Their results provide significant support for a neurochemical link to economic preferences and risk aversion. The results of their studies identified a

“significant dependence [of financial risk taking] on the measures of neurochemical activity and sensation-seeking . . . high MAO levels, low levels of sensation-seeking, nonimpulsivity and introversion tend to be associated with more risk-averse behavior, providing support for a correlation between behavioral traits and economic preferences.” (Harlow and Brown, 1990a, p. 60)

In other words, a biological and behavioral framework established by sensation seeking and biochemical characteristics can be postulated that make an individual more willing to accept financial risk. Other behavioral attributes of sensation seekers are also associated with adverse credit history (e.g., impulsiveness, seeming irresponsible behavior, etc.).

There is more than a simple correlation involved, however. Recent developments in pharmacology have inadvertently provided further substantiation for a potential causal link between individual biochemistry and the types of risky financial behavior (compulsive buying, risky and impulsive decision making, etc.) adversely affecting one's credit score (and driving behavior). An article published in the journal *Neurology* by Driver-Dunckley, Samanta, and Stacy (2003) reported that of the 529 Parkinson's disease patients who took the dopamine agonist drug Mirapex, a significant number (eight) developed gambling addictions. Taking the drug Mirapex (pramipexole) and changing dopamine levels resulted in bankruptcies, excessive shopping, unsafe sex,

and other impulsive and compulsive behaviors which were not present in the patients before taking the drug. After removal of the drug, the behavior stopped. A follow-up study conducted at the Mayo Clinic (Dodd et al., 2005) confirmed these findings. In a newspaper interview (Associated Press, July 12, 2005), the first author of the Mayo Clinic study said that when the patient experiencing compulsive behaviors (after taking Mirapex) discontinues the drug, the change is dramatic, "like a light switch being turned off when they stopped the drug." The connection between dopamine levels and driving behavior has already been detailed, and the relationship between dopamine and sensation seeking/novelty seeking and impulsive behavior has also been documented (c.f., Zuckerman, 1990).

Stress, such as that generated by bad credit history and its ramifications, can actually change one's biochemistry (cortisol) and neurotransmitter levels (c.f., Antelman and Caggiula, 1977; Roberti, 2004; Garrity and Demick, 2001). Stress and the corresponding biochemical changes are also known to affect driving and accident rates (Matthews, Dorn, and Glendon, 1991). Additionally, individuals under financial stress might also be more susceptible to being involved in accidents due to inadequate focus on proper operation or maintenance of a vehicle and due to distractibility. Moreover, when involved in an accident, such financially strapped individuals are more likely to act irresponsibly and increase the claimed severity of damage in order to increase insurance payments.

After an accident, the insured's financial actions and decisions concerning whether or not to file insurance claims (and how much to claim) can also be indicative of risk taking behaviors. Their decisions may be related to their financial condition, providing another link between credit status and incurred losses. Individuals with a poor financial history are more likely to be in debt and, therefore, more likely to file insurance claims for the purpose of obtaining capital. Insureds without financial stress can choose to have higher deductibles, or to not file a claim to keep premiums lower over the long term.

Personal responsibility and risk taking behaviors also extend to credit card use. The rise in consumer debt and bankruptcies is the result of increased levels of impulse, or erratic, buying and a decline in the individual's willingness to delay gratification by saving for the future (Wood, 1998). These characteristics are associated with sensation seeking personality, which we previously observed in discussing automobile accident propensity. Education, age, and gender were all independently and significantly related to impulse buying, with the highest level of impulse buying reported by individuals with some college education, but not a degree.

Financial satisfaction is a result of financial practices (cash management, credit management, budgeting, financial planning, and general money management), household income, and financial stress. Those individuals who experienced high levels of financial stress tended to be less satisfied with their personal finances (Gable and Joo, 1999). Lea, Webley, and Walker's (1995) study of nondebtors and debtors suggested that debt is part of a pattern of dysfunctional economic behavior, i.e., decline in financial status, weak money management, low income, and/or insecure housing. Once the debt was incurred and increased, their attitude toward debt became more tolerant (Davies and Lea, 1995). Heck (1980), Waller (1990), and O'Neill, Lytton, and Parrott (1995) studied homeowners experiencing financial difficulties with a stress-inducing

significant life experience, such as loss of income, unexpected medical bills or illness, divorce, or financial mismanagement—the most often cited problem. O'Neill, Lytton, and Parrott's study revealed that a full quarter of the subjects had a negative net worth and the average value of the liquid assets for the household was only \$708. Over 80 percent of the subjects noted that their financial situation had worsened in the previous year. Sullivan and Fisher (1988) found that renters were almost twice as likely as homeowners to have debt repayment difficulties.

Dunn and Kim (1999) identified three predictors of credit card default: (1) total minimum required payment to income ratio, (2) percentage of the consumer's total credit line that has been used, and (3) the number of cards that have been maximized. Those who did not default had higher incomes and larger credit lines, carried lower balances, and had approximately half the debt-to-income ratio as the default group. Generally, those who defaulted were younger and were less likely to be married or homeowners. The likelihood of default for married cardholders increased with the number of children. Stavins (2000) also found that households that filed for bankruptcy had significantly higher credit card debt-to-income ratios and had carried higher unpaid credit card balances than those households that had not filed for bankruptcy.

A discriminant analysis conducted by Grable (2000) also indicated that risk tolerance (the opposite of risk taking) was significantly related to being older, married, having higher education levels, being professionally employed with higher incomes, having more financial knowledge, and increased financial expectations. Grable also concludes that the achievement of financial success can be explained in part by a combination of personality characteristics and socioeconomic background. It is worth noting that Tillman and Hobbs (1949) found that high-accident taxi drivers also exhibited instability, school-related problems, short-term adult employment, were often fired by employers, and had credit problems, showing that the same problems identified as being exhibited in individuals with credit problems are also found in individuals with bad driving behavior.

The above-mentioned factors relating to financial stress and financial risk tolerance have a direct impact on the individual's credit score. Kellison et al. (2003) established that the lower an individual's credit score, the higher the likelihood that the insured will incur losses on an automobile insurance policy, and the higher the expected loss on the policy. Automobile insurers have given lower insurance rates to good students, to married men, and to older individuals, all of which partially tap the "responsibility and stability" component of an individual's character and behavior and all of which have been shown to relate strongly to insured losses. A good credit score is also a sign of responsibility and stability. The fact that the strong relationship between credit scores and insured losses continues to hold, even after the impact of traditional actuarial underwriting variables such as age, marital status, gender, driving history, etc. are factored out, indicates that the credit scoring is tapping an underlying dimension of risky behavior that goes beyond, or provides a stronger or purer assessment of responsibility and stability than, those encompassed by traditional actuarial variables.

In summary, a neurochemical and a psychological link has been found connecting risk taking propensity to economic preferences.

- Risk perception and risk appraisal play an important role in the individual's propensity for sensation seeking, which in turn is an integral part of the individual's financial decision making.
- Risk tolerance is evident in behavior such as the filing of insurance claims, credit card use, debt-to-income ratio, and personal investments. These also directly impact the individual's credit score.
- Importantly, the same or similar biochemical factors (testosterone, dopamine, MAO, cortisol, etc.) and psychological personality types (sensation seeking, Type A personality) are found to occur in studies of insured automobile losses and everyday financial decision making affecting one's credit score.

SUMMARY AND CONCLUSIONS

The ceaseless search for better and more accurate variables to use in predicting insurance losses has been ongoing since the beginning of insurance underwriting. Many underwriting variables are clearly related to the losses they are designed to predict (e.g., automated sprinkler system installation for insured fire loss, seat belt and security alarms for automobile insurance, employment activity for workers compensation insurance, etc.) and have been used for decades. Others (e.g., marital status, gender, and "good student" status in automobile insurance) are also of long standing; however, the relationship between the variable and the loss it is intended to predict is less readily apparent. In fact, their usefulness as an underwriting variable stems from their being a proxy for stability and responsibility not from their direct link to automobile accidents.

Actuaries, recognizing the impossibility of proving "causality" for all useful and predictive variables, have addressed the fact that not all useful predictor variables can be clearly visible as "causal." The result is a standard that helps determine when a variable is permissible for use and when it is not (Actuarial Standard 12). This standard prescribes that it is not necessary to understand the "black box" mechanism by which a variable predicts losses, if it can be exhibited statistically to be related to the loss and does not discriminate in an unlawful way. This has been publicly acceptable for decades, but the acceptability of Actuarial Standard 12 as a standard is questioned with the new underwriting variable "credit score." No one has previously delineated why credit scoring works to predict losses and this lack of rationality has jeopardized its use, in spite of its clear statistical connection.

This article proposes a connection between credit behavior and driving behavior supported by providing a summarization of research linking biological and psychological factors common to both risky driving and financial decision making. An exhaustive literature review makes clear that there are intrinsic underlying individual biological and psychological characteristics of risk taking in financial behavior and driving which warrant further investigation. The same or similar personality types (sensation/novelty seeking, Type A personalities) and similar biochemical profiles occur in individuals who exhibit lack of responsibility in driving or in financial matters. Lack of stability and impulsive behavior affect both driving and credit history. Biological traits involving levels of dopamine, MAO, cortisol, and testosterone, for example, simultaneously impact an individual's financial and driving outcomes. Stress levels, such as those caused by financial distress, impact certain biochemical levels

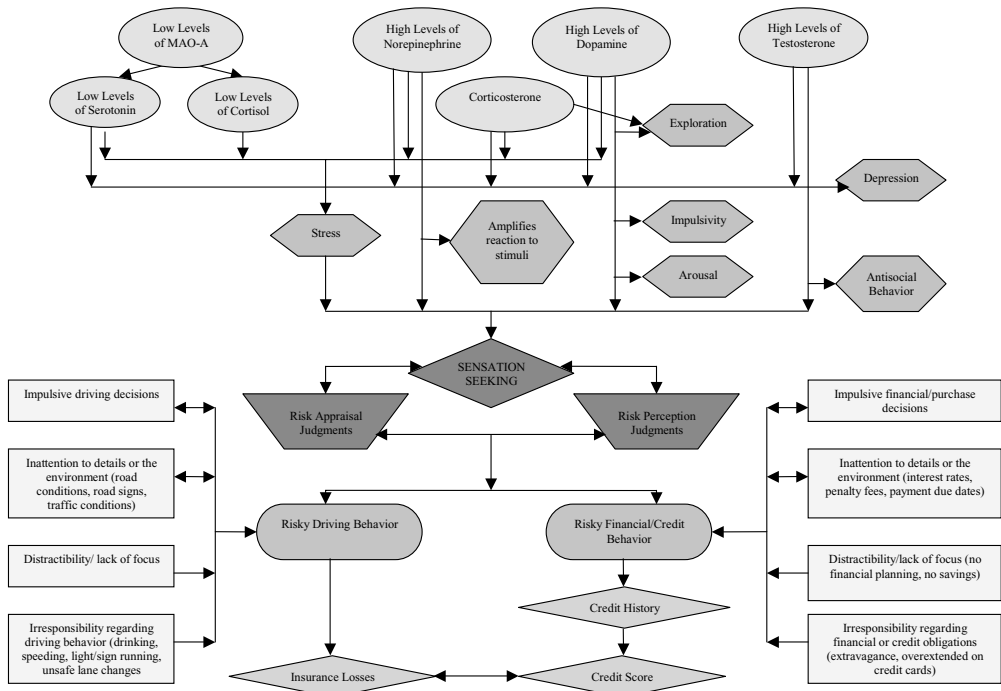
and increase distractibility, which in turn impacts both credit scores and driving results. Individual biochemical and personality profiles affect educational attainment, job and income stability, marital stability, where one lives, and the type of car one chooses (and can afford) to drive. It affects how one reacts to an accident, how one files an insurance claim, and how one follows through on a claim after an accident. In short, the behavior is pervasive in driving and in other aspects of life, including credit behavior. Figure 6 summarizes these relationships.

The results of this article suggest that further research is desirable delineating the biological and psychological linkages to credit risk and financial decision making in general. Much can be learned about financial decision making by examining biological predisposition, and this research would have direct implications for both credit counseling and financial behavior control mechanisms. Psychobehavioral and biological linkage to financial decision making also has implications for other economic areas of study such as consumer behavior, marketing, advertising, management, driver education, financial planning, financial management, public education, curriculum development, etc.

The research in this article suggests that the discussed individualized biological and psychobehavioral correlates provide a connection between credit scores and automobile insurance losses.

FIGURE 4

Biological and Psychobehavioral Correlates of Risk Taking, Credit Scores, and Automobile Insurance Losses



tap a dimension of responsibility and stability for the individual that can permeate multiple areas of behavior. A useful follow-up study could simultaneously collect information on the same set of individuals, which includes insured losses and credit information, together with biological and psychological measurements. The resulting analysis relating biological and psychobehavioral characteristics of credit scores to insured losses would definitely answer the question of why credit scoring works.

APPENDIX

TABLE 1
Driving Risk Behavior Research

Citations	Biological/Chemical/Genetic Sociopsychological Demographic Behavioral				Key Findings
	(a)	(b)	(c)	(d)	
Arnett, 1990		X		X	• Drunk driving significantly related to ◦ total SSS ◦ thrill and adventure seeking subscale ◦ disinhibition subscale ◦ and egocentrism • but not significantly related to boredom susceptibility subscale • Sensation seeking and egocentrism significantly correlated • Drunk driving is motivated by a propensity for sensation seeking
Arnett, Offer, and Fine, 1997		X		X	• Sensation seeking and aggressiveness significantly related to reckless driving • Sensation seeking and aggressiveness significantly correlated and adolescents were higher than adults on both traits • Participants drove faster when angry and when alone or with friends than with parents
Burns and Wilde, 1995				X	• High-risk personalities (need for more tension, risk, and adventure in their lives) associated with driving at excessive speeds and carelessly changing lanes • Sensation seekers more frequently convicted of speeding and other traffic violations than others

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Caspi et al., 1997		X			• No relationship was found between collision history and personality or observed driving behavior • Personality differences such as alcohol dependence, violent crimes, unsafe sex, and dangerous driving habits predict health risk behavior in young adults ◦ Undercontrolled three-year olds are significantly more likely to be involved in health risk behaviors at 21 ◦ Persons who at the age of 18 scored lower on traditionalism, harm avoidance, control, and social closeness, and higher on aggression and alienation were significantly more likely to become involved in health risk behavior at the age of 21 ◦ Persons who at the age of 18 scored low on constraint and high on negative emotionality were significantly more likely to be involved in either one or in multiple health risk behaviors at the age of 21
Chliaoutakis, Darviri, and Demakakos, 1999			X	X	• Lifestyle is an important factor determining high road traffic accident rates ◦ Young drivers whose dominant lifestyle trait is alcohol consumption or driving without destination have high-accident risk ◦ Those whose dominant lifestyle trait is culture face low accident risk • Accident risk was also significantly related to young drivers being religious or not • Young male drivers are more vulnerable than young female drivers
Donovan, 1993		X		X	• Drivers who drive more frequently after drinking also ◦ drive more frequently under the influence of marijuana ◦ tend to break traffic rules more frequently • Drinking-driving significantly correlates with ◦ psychological unconventionality ◦ risk taking ◦ and hostility/aggression
Donovan, Umlauf, and Salzberg, 1988		X		X	• Two main subtypes among high-risk drivers are ◦ characterized by impulsivity, sensation seeking, and aggression ◦ characterized by high levels of depression, emotional distress, resentment and an external perception of control ◦ many young drivers use cars as a way to resolve anxiety and conflict
Farrow, 1985		X		X	◦ Traffic violations and citations significantly correlated with

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Finn and Bragg, 1986		X			○ increases in risky driving behavior ○ alcohol and drug use ○ poor academic performance ● Young male drivers are overrepresented in traffic accidents at least in part because ○ they are more willing to take risks than older drivers and/or ○ they fail to perceive specific driving situations as being as risky as older drivers perceive them ● Young drivers perceive their own chances of an accident to be significantly lower than those of both their peers and older male drivers ● Older male drivers perceive their chances of accident involvement as comparable to those of their peers and less than those of young male drivers
Furnham and Saïpe, 1993		X			● Convicted drivers (nonalcoholic offences) scored high on ○ psychoticism ○ neuroticism ○ thrill and ○ boredom susceptibility ● Males scored high on psychoticism, thrill and adventure seeking, and boredom susceptibility, but lower on neuroticism. Males had more convictions than females ● Younger people tended to score higher on extraversion, psychoticism, and thrill and adventure seeking, but lower on the lie scale ● Younger people were more likely to have accidents than older people ● Risk taking and demographic variables correlate with convictions much more than driving accidents, and there is a significant negative correlation between accidents and conviction ● Aggression was significantly related to ○ extraversion (0.32) ○ neuroticism (−0.24) ○ lie (−0.20) ● Law breaking significantly related to ○ gender (−0.40) ○ age (−0.40) ○ thrill (0.50) ○ convictions (−0.33) ○ boredom (0.29) ○ psychoticism (0.45) ○ neuroticism (−0.20) ○ lie (−0.20)

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Garritty and Demick, 2001		X		X	• Cautiousness while driving for young adults significantly related to ◦ negative correlation with mood states of depression-dejection ◦ negative correlation with anger-hostility ◦ negative correlation with fatigue-inertia ◦ negative correlation with tension-anxiety ◦ positive correlation with vigor-activity • Older drivers were better at responsiveness • Relative to older- and middle-aged drivers, young drivers were better at maneuvering and observation • Relative to young drivers, middle-aged and older drivers were better at cautiousness • Young drivers had higher means relative to middle-aged and older drivers on ◦ anger hostility ◦ confusion-bewilderment ◦ depression-dejection ◦ fatigue-inertia ◦ tension-anxiety ◦ and lower vigor-activity
Gregersen and Berg, 1994					• Personality traits not significantly related to driving • There is a high probability of a relationship between lifestyle and accident risks in traffic ◦ All young drivers do not have the same high-accident risk ◦ Among young drivers, women's risk is lower than men's ◦ Alcohol consumption is related to accident risk as well as weekend and nighttime driving ◦ Driving with extra motives like showing off and impressing, sensation seeking, competition, pleasure are related to driving risk
Harrington, 1972			X	X	• Harrington study found that ◦ teenagers have roughly twice as many accidents and three times as many convictions per year as general driving population ◦ teens drove only 50% as many miles as adults ◦ male and female teens had almost identical accident rates but males had more traffic convictions ◦ excessive speed was the most common traffic violation, followed by equipment violations ◦ alcohol was not a large factor in fatal and injury accidents of teens ◦ frequency of accidents increased with increased traffic convictions, low citizenship grades, and high mileage

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
					○ poor citizenship grades significantly associated with higher rates of moving traffic convictions ○ high-accident subjects reported more socially deviant past activities, poorer school and parental relationships, more traffic convictions, higher driving mileage, more involvement with cars during high school, and more emotionally involved driving ○ high-accident males rated themselves as enterprising, aggressive, dissatisfied, generous, affectionate, lively, adventurous, sensitive, emotional, modest, sophisticated, assertive, and tough ○ high-accident females reported themselves as conventional, persevering, polished, self-controlled, friendly, decisive, orderly, sophisticated, and less frank ● Goldstein review provided support for Harrington study; however, alcohol was a very significant factor in fatal accidents of drivers under 25 ● Risk perception and risk choice implicitly involve an attitude or sense of personal vulnerability and recognition of vulnerability may be the single most important mechanism underlying risk taking
Iversen and Rundmo, 2002		X		X	● Three dimensions of driver anger were identified—discourtesy, police presence and traffic obstructions, and hostile gestures ● Risky driving can be predicted by ○ sensation seeking (0.31) ○ normlessness ($\beta = 0.26$) ○ driver anger ($\beta = 0.25$) ● Accident involvement is significantly associated with ○ risky driving ($\beta = 0.41$) ○ sensation seeking ($\beta = 0.20$) ○ driver anger ($\beta = 0.09$)
Jonah, 1986		X	X	X	● Young drivers (16–25) are at a greater risk of being involved in a casualty accident than older drivers ● Risk of being in an accident is a function of young drivers' propensity to take risks while driving ● Perceived risk and risky driving are negatively correlated ● Perception of driving behavior may be initially perceived as risky, but individual becomes willing to accept the risk and once the behavior results in positive consequences, the perception of risk is lowered

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Jonah, 1997	X	X	X	X	• A review of the literature on sensation seeking as a direct influencer of risky driving and its consequences and as a moderator of the influence of other factors ◦ Sensation seeking may moderate the manner in which drivers respond to other factors such as alcohol impairment and perceived risk ◦ Majority of studies reviewed showed positive relationships between sensation seeking and risky driving (correlations between 0.30 and 0.40), depending on gender, measure of risky driving, and SSS employed ◦ Subscales of Zukerman's SSS, thrill and adventure seeking scale appear to have the strongest relationship to risky driving ◦ Neurotransmitters like dopamine, NE, and serotonin underlie the trait of sensation seeking
Jonah and Dawson, 1987			X	X	• Young drivers (16–24) take greater risks while driving than older ones (25+). Therefore, age is a good predictor of risk taking while driving • Young drivers under 25 are more likely than older drivers to report ◦ following too closely ◦ passing at intersections ◦ driving through yellow lights ◦ changing lanes abruptly ◦ driving fast ◦ driving while impaired ◦ getting involved in accidents ◦ committing traffic violations ◦ not using safety belts • Risky driving increased with distance traveled but decreased with age, self-rated level of cautiousness, and danger perception • Speeding decreased with age, cautiousness, perceived danger, and safety utility, but increased with distance traveled • Belt usage increased with attitude toward automatic belts, danger perception, and safety utility • Impaired driving decreased with age and perceived effectiveness • Total number of accidents and traffic violation decreased with age and increased with distance traveled
Lastovicka et al., 1987				X	• Based on lifestyle traits linked to drinking-driving behaviors, a segmentation typology of young males is developed

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
					○ The Good Timers—representing 23% of sample, heavy partiers with a macho and sensation seeking orientation who have little problem behavior. They report highest drinking-driving ○ The well-adjusted—27% of sample, claim to be the happiest, average in partying and macho tendency, and report next to lowest incidence of drinking-driving ○ The Nerds—24% of sample, most dissatisfied with themselves, below average in problem behavior, partying, sensation seeking, and macho orientation. They have the lowest reported drinking-driving problem ○ The problem kids—24% of sample, average problem behavior tendency, average profile on all other factors, and have the second highest level of reported drinking-behavior
Matthews, Dorn, and Glendon, 1991		X			● General driver stress significantly correlated with ○ EPQ N Scale and minor accident involvement ○ frequency of daily hassles and aggression ○ poorer self-rated attention ○ stressed mood states
McMillen et al., 1992		X			● Drivers under the influence apprehended in conjunction with an accident or moving violation had significantly greater ○ alcohol consumption ○ frequency of driving after drinking ○ frequency of driving impaired ○ traffic violations ○ accidents ○ and self-rating of risk taking after drinking in comparison with other groups ● The highest risk groups includes individuals apprehended for driving under the influence as a result of an accident or moving violation
McMillen, Smith, and Wells-Parker, 1989		X		X	● Study investigates the role of expectancy of alcohol consumption in driving risk taking ○ Sensation seeking had significant effect on lane changes-cars passed ○ Risk taking was greater among high sensation seekers who believed they had consumed a moderate amount of alcohol than among high sensation seekers who believed they had not consumed alcohol ○ Low sensation seekers who believed that they had consumed alcohol displayed less lane changes-cars passed than low sensation seekers who believed that they had not consumed alcohol

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Miles and Johnson, 2003		X		X	• In essence, high sensation seekers seem to respond to an awareness of consumption by taking more risks and low sensation seekers seem to respond to an awareness of consumption by becoming more cautious. • Alcohol consumed did not produce a significant main effect or interaction • Traffic violators scored higher than students on ◦ driving behaviors scales ◦ seven-item attitude scale ◦ summated type-A behavior pattern items • Violators scored lower than students, although not statistically significantly, on summated scores for ◦ agreeableness ◦ conscientiousness ◦ and neuroticism • Females within student sample reported significantly lower driving skill than males and these differences are not observed in violators sample • In conclusion, there may be a key distinction between aggressive driving and road rage analogous to the distinction between instrumental and direct/hostile aggression
Parker et al., 1992		X	X		• Young and male drivers find it more difficult to refrain from committing traffic violations than old and female drivers, respectively • Young and male drivers are less concerned and less aware of negative outcomes of traffic violations
Parsons, Siegel, and Cousins, 1997		X			• Among late adolescents, perceived benefits are better determinants of behavior change for risk taking behavior than perceived risks; however, both are important determinants of behavior intentions • Females reported significantly ◦ less involvement, greater perceived risks, greater involvement, lower perceived benefits for the stereotypic male behavior factor than males ◦ greater involvement for socially acceptable factor than males
Perry, 1986				X	• Subjects exhibiting Type A behavior (chronic sense of time urgency and impatience) ◦ are more impatient ◦ report being involved in more accidents ◦ and receive more tickets than those scoring low on Type A scale
Robertson, 2002				X	• Author argues against risk homeostasis theory suggesting that the evidence for it is deeply flawed

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Rothengatter, 2002		X		X	• The most compelling argument against risk homeostasis is the observation that occupant death rates in passenger cars per distance traveled fell by nearly two-thirds in the United States from 1964 to 1990. A comprehensive study of the effect of vehicle modifications, laws on use of seat belts, and reductions in drunk-driving indicates that about 90% of this reduction was due to vehicle modifications • A review of theories and models pertinent to drivers' risk taking and road user behavior. It is argued that traffic psychology has not had a major impact on accident prevention ◦ Risk-homeostasis and task capability model are not precise enough to be used as a basis for preventive measures ◦ Attitude-behavior models from social psychology, although majority of them are based on self-reported measures rather than observed behavior, are powerful in identifying motivational factors influencing road user behavior
Shinar and Compton, 2004				X	• Relative to their proportion in population, men are more likely than women to commit aggressive actions • Drivers over 45 are less likely to drive aggressively than younger ones • Aggressive driving significantly positively related to the value of time
Sommers et al., 2000		X		X	• 61% of seriously injured drinking drivers do not use safety restraints for one or more reasons • 16.5% of young adult drinking drivers used safety restraints as compared to a national norm of 68% • 84% of young adult drinking drivers used at least one tobacco product per day as compared to a national norm of 47% • 58% of young adult drinking drivers used marijuana compared to a national norm of 24% • Non-alcohol-dependent, young adult drinking drivers demonstrated a pattern of risky behaviors that exceeded national norms
Summala, 1988				X	• Review article that discusses zero-risk theory, and argues that controlling for risk is not the same thing as adjusting risk ◦ Driving is habitual and largely automatized activity ◦ Different kinds of utilities associated with high speed, plus the extra motives, tend to push drivers toward faster driving and higher risks ◦ Adaptation to risk is largely a function of increasing self-confidence

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
					○ Drivers' speed-utility functions are distorted by perceptual, cognitive, and motivational factors ● The probability distribution of possible outcomes in driver decision making is also severely distorted: the driver learns to discard small stochastic risks
Taubman Ben-Ari, Florian, and Mikulincer, 1999		X		X	● No significant main effects for mortality salience and driving as relevant to self-esteem on reckless driving ● Young people reacted to mortality salience induction with higher reported proneness to reckless driving only when they perceived driving as relevant to their self-esteem in both self-reported and behavioral measures. Introduction of positive feedback about driving eliminated this effect
Tillman and Hobbs, 1949		X			● High-accident taxi driver most frequently comes from a home marked by parental divorce and instability, childhood marked by evidence of instability and disrespect for organized authority ● In adulthood, occupation record marked by frequent short-term employment, and connections with any firm are frequently terminated by employer. Has police record apart from traffic violations and his personal life is marked by evidence of social disregard as noted in other aspects of life ● His driving marked by aggressiveness, impulsiveness, and lack of thought for others
Tsuang, Boor, and Fleming, 1985		X		X	● A review of studies on nonpsychiatric and psychiatric samples examining the roles of suicide, life events, alcohol, and drugs ● Certain personality characteristics and psychopathology factors such as ○ low tension tolerance ○ less control of hostility and anger ○ less conformity ○ immaturity ○ personality disorders ○ more difficulty with authority figure ○ hyperactivity ○ belligerence ○ alcoholism ○ and paranoid conditions are risk factors for traffic accidents ● Personality characteristics responsible for traffic accidents correlate with age ● Several studies found conscious and unconscious suicidal motivations to play significant role in traffic accidents

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Turner and McClure, 2003		X		X	• Males scored significantly higher to females on driver aggression score scale. There were no age differences on driver aggression score scale • There was no statistical difference between males and females on thrill seeking score scale. They were inversely related to age • Males scored significantly higher on risk acceptance score scale than females. As age increased, risk acceptance decreased • In conclusion, the increased risk of a crash can, in part, be explained by the age and gender differences in risk taking behavior (young over older, males over females)
Turner and McClure, 2004		X			• Significant differences in ages of cases (people hospitalized for injuries following a crash) and the control group with 23.6% of cases belonging to 17–24 age group compared to 1.2% of controls belonging to same age group • Significantly less cases in 40–60 age group compared to controls • Significantly higher proportion of cases never married compared to controls ◦ Proportion of controls belonging to each level of education was similar but for cases it varied with larger proportion having completed high school ◦ Cases more like to be tradespersons or laborers compared to controls who were more likely to be clerks/salespersons ◦ Significantly higher proportion of cases scored high on driver aggression compared to controls ◦ Majority of cases scored lower on risk acceptance scale than controls • There were no significant differences between cases and controls on gender, employment status and thrill seeking • Drivers with high risk acceptance scores were eight times more likely to have crashed than those with low score • Drivers with high driver aggression score were twice as likely to have a crash than those with low score • Surprisingly, a high score on thrill seeking scale was associated with reduced risk of a crash
Ulleberg and Rundmo, 2002		X		X	• Adolescents (proportionate to their numbers in general population) more frequently involved in traffic accidents than other age groups • 11 dimensions of risk taking attitudes were identified

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Ulleberg and Rundmo, 2003		X		X	• The attitude dimensions significantly correlated with self-reported driving behavior and accident frequency • Stronger correlation between driving attitudes and behavior than driving attitudes and accident involvement • Personality variables altruism, anxiety, normlessness, sensation seeking, and aggression all significantly correlated with ◦ risk perception ◦ attitudes toward traffic safety ◦ and risky driving behavior • Risk perception and attitude toward traffic safety correlated with reported risk taking in traffic • Risk perception not related to risk behavior. 47% of variance in attitude toward traffic safety explained by personality traits
Vavrik, 1997		X		X	• Individuals in high-risk group scored significantly higher on measures ◦ affiliation ◦ desirability ◦ dominance ◦ exhibition ◦ and self-esteem
West, Elander, and French, 1993		X			• Innovation scores lower for high-risk group • Social deviance significantly positively correlated with accident rates independent of age, gender, and annual mileage • Association between social deviance and accident rates partly mediated by faster driving speed • Variation in social deviation predictive of traffic accident risk
Whissell and Bigelow, 2003		X			• In a college student sample there was ◦ significant but low correlation between SAS and speeding tickets ◦ significant correlation between SAS and SSS • Males had higher SAS scores and more speeding tickets. Accidents were typically a function of gender, increasing age, and variables related to recent accident history
Wilson and Jonah, 1988		X		X	• Significant correlation between drug usage and thrill seeking suggesting that risky driving is part of a problem behavior syndrome • Personality system accounted for double the amount of variance in risk driving accounted for by perceived environment

Continued.

TABLE 1
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
					• Problem behavior theory (PBT) predicted substantial proportion of variance in risky driving • PBT can be extended to the prediction of the consequences of risky driving • PBT is applicable to different samples of drivers (driving while intoxicated, high risk, and general population) • Ability of PBT to predict driving risk index decreased with age

TABLE 2
Financial Risk Behavior Research

Citations	Biological/Chemical/Genetic (a)	Sociopsychological (b)	Demographic (c)	Behavioral (d)	Key Findings
Brockhaus, 1980		X			• Contrary to the theory—entrepreneurs are more moderate risk takers than managers—there are no significant differences in risk-taking propensities between entrepreneurs and managers
Davies and Lea, 1995			X	X	• Religion, age, number of credit cards used, and more tolerant attitude toward debt have significant effects on student group surveyed. Student debtors tend to ◦ be older ◦ have more pro-debt attitude ◦ have several kinds of debt ◦ worry less about the level of their bank account ◦ be male • No significant association of levels of debt with ◦ income ◦ expenditure patterns ◦ locus of control ◦ life experiences • Significant positive correlation of tolerant attitude with ◦ age ◦ some kinds of expenditure

Continued.

TABLE 2
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Dunn and Kim, 1999				X	○ religion ○ external locus of control ● Students who have been at university longer are associated with higher levels of debt and greater tolerance of debt. The increase in debt occurred earlier in students' career than the increase in tolerance ● Probability of credit card default is significantly positively affected by ○ total minimum required payment to income ratio ○ percentage of total credit line which the consumer used ○ the number of credit cards on which the consumer has charged to the credit limit ● Total credit card debt-to-income ratio not significantly related to credit card default ● Credit card defaulters tend to ○ have lower credit line ○ have more credit cards ○ have higher minimum payment ○ have higher minimum payment-to-income ratio ○ have higher balance carry-to-income ratio ○ be single ○ have, when married, more children ○ be younger than nondefaults
Freddie Mac National Consumer Credit Survey				X	● Poor credit record is a relatively common problem ● Credit problems persist across income groups ● Minority borrowers more likely than white borrowers to experience credit problems ● People have a reasonably accurate sense of their credit records ● People get into credit difficulties as a result of inability to follow successful financial behaviors, external events that create financial stresses, lack of knowledge about financial and credit matters, and a poor economic safety net
Grable and Joo, 1999	X	X	X		● In sample of white-collar clerical workers, the following factors were significantly related (can be used to predict) to financial risk tolerance: ○ education (0.24) ○ income (0.21) ○ ethnicity (−0.22) ○ financial knowledge (0.21) ○ home ownership (−0.17) ○ number of dependents (−0.17) ○ financial solvency (0.18)

Continued.

TABLE 2
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Harlow and Brown, 1990a, 1990b	X	X			• Age, gender, and marital status were not significantly related to risk tolerance when financial knowledge and income are accounted for • Risky behavior ◦ negatively correlated with MAO & social introversion ◦ positively correlated with sensation seeking for males • Although general sensation seeking (Gen) significantly correlated with risk tolerance measures, only thrill and adventure seeking subscale (TAS) was significantly correlated and the other three subscales were not significantly correlated
Hayhoe, Leach, and Turner, 1999			X	X	• Students with four or more credit cards ◦ scored higher on the affective credit attitude than students with no credit cards ◦ thought more about consequences of using credit ◦ scored lower on the retention and obsession money attitude ◦ tended to be female and older than students with no cards ◦ were less likely to borrow from friends or relatives to meet financial emergencies
Heck, 1980			X		• Money and credit attitudes affect behavior • Review article that identifies several characteristics of insolvent households • Financial characteristics ◦ Bankrupt households tend to be at the lower end of income spectrum ◦ Have high debt-income ratios ◦ Use credit more, with finance companies being the main source of credit • Demographic characteristics ◦ Typical bankrupt tends to be a male in late 20s or early 30s ◦ Bankrupt petitioners have a four-member household and are at the child-bearing stage of the family life cycle ◦ A few studies conducted in single localities with small samples found that the majority of bankrupt individuals are Caucasian, while other studies have found a higher frequency of blacks ◦ Several studies found incidence of marital difficulty and divorce to be high in their samples of bankrupts ◦ Education levels of bankrupts found to be consistently less than the general population

Continued.

TABLE 2
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
					○ Bankrupt individuals tend to be blue-collar workers ○ Tend to move frequently within the same general locality about twice as often as nonbankrupts ● Social attitudes ○ Bankrupts tend to be ○ low in social aspirations ○ high in social concern or authoritarianism ○ low in social pessimism ○ and high in fatalism ○ Bankrupt individuals tend to be more emotionally immature and lacked frustration tolerance. Other common personality traits are ○ evasive ○ worrying ○ easily annoyed ○ shy ○ withdrawing ○ cautious and ○ retiring ● Other conditions ○ higher unemployment rate ○ unexpected medical expenses ○ wage garnishment
Kellison et al., 2003			X	X	● There is a significant relationship between credit score and incurred losses (lower credit scores associated with higher incurred losses) ● Standard underwriting variables do not explain the observed relationship between credit scores and incurred losses
Lea, Webley, and Walker, 1995		X			● Debtors are more likely to ○ be women, employed part-time, housewives or be unemployed, to be in low income groups, rent homes than own, and have more children in their household ○ report that their family and friends would understand if they owed money on bills ○ report that parents' financial situation is better than their own ○ report that they had less money than their friends, relations, and people at work ○ report missing appointments ○ need a bigger reduction to switch to a precommitment method of payment of bills ● Debtors are less likely to ○ have a bank or building society account

Continued.

TABLE 2
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
					- o own cars or telephone and more likely to report buying cigarettes and Christmas presents for children • No significant differences between nondebtors, mild debtors, and serious debtors on attitudes toward debt scale and locus of control scale • Nondebtors have more money management facilities and rated their money management abilities higher than debtors • Debtors had shorter time horizons than nondebtors • Significant differences between three groups for measures of economic socialization, social comparisons, use of credit, and other aspects of consumer behavior, but these differences were not independently significant on multivariate analysis
MacCrimmon and Wehrung, 1990		X		X	• Success, when it had a significant relationship with risk propensity, was always positively associated with risk taking, i.e., higher degree of success (greater wealth and income, higher position, greater authority) differentiated risk takers from risk averters • Risk-averse managers are older, have longer seniority, and fewer dependents • There was no significant relationship between nationality, education, and risk taking or risk aversion
Masters and Meier, 1988		X	X	X	• No differences were found in risk taking propensity between entrepreneurs and managers • No differences were found between risk taking propensities of male and female entrepreneurs
Monaghan, 2000		X	X	X	• Strong significant correlation between credit history and future personal lines loss performance • Both historic and current variables in credit history data have a strong influence on loss performance • Long-tenured customers have better credit profiles than newer ones • Individuals with poor credit history - o are more likely to be in debt - o have greater incentive to file claims - o are more likely to increase claims - o are more likely to file more claims
Morse, 1998		X		X	• Individuals can accurately judge risk level of investments with a high degree of accuracy for all but the riskiest categories • Knowledge of risk was unrelated to the actual risk level of investments • There is no significant correlation between self-reported risk level and overall risk level of actual investments

Continued.

TABLE 2
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
O'Neill, Lytton, and Parrott, 1995			X	X	• There is no significant relationship between the level of sensation seeking and risk level of chosen investment • There was no significant relationship between demographics (age, education, and gender) and the risk level of investments • Overextended homeowners ◦ are young or middle-aged, majority with high school or postsecondary education, average household income of \$20,000 less than the median income with mortgage payments over \$1,000/month ◦ have inadequate emergency savings, lack invested assets, owe more for monthly expenses than they earn ◦ did not appear to rely on credit to solve their problems ◦ had experienced a significant life event such as job loss
Olson, 1994			X	X	• Families successful in eliminating debt engage in more different behavioral adjustments (managerial activities) than unsuccessful ones • There are no significant differences between successful and unsuccessful families in ◦ rescaling the level of consumption ◦ changing income adequacy • Significant difference in the implementation of managerial activities between the successful and unsuccessful families • Families in debt as a result of uncontrollable events are more likely to make behavioral adjustments by increasing income adequacy and managerial activities
Shanteau, 1992		X		X	• Study presents an overview of psychological literature on decision making with emphasis on insurance behavior ◦ People believe that it is improbable for an unlikely event to recur ◦ Natural events are viewed differently than man-caused events ◦ The amount of insurance subjects are willing to buy changed little across conditions and beliefs about insurance unaffected by events in the preceding year • People tend to ◦ have limited cognitive capacity to process low probabilities ◦ focus more on loss probability than magnitude

Continued.

TABLE 2
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
					○ are risk averse for gains but risk seeking for losses ○ misperceive randomness of runs ○ seek an optimal level of risk ○ show wide individual differences in risky decision making ○ are resistant to changing attitudes and beliefs about risks ○ exaggerate their decision making ability ○ are influenced by subtle shifts in problem wording ○ cannot conceptualize losses they have not experienced
Stavins, 2000			X	X	● Personal bankruptcy significantly correlated with ○ credit card borrowing ○ credit card default rates ● Probability of being behind on payments positively related to unpaid balances on credit cards, filing for bankruptcy in the past year, and been unemployed any time during last year ● Having more credit cards, health insurance, being married, having higher income reduces the likelihood of delinquency ● Older and more educated consumers have lower probability of being behind on their payments
Sullivan and Fisher, 1988			X		● Income is not a good indicator of credit risk among young borrowers ● As the household head aged, the probability of payment difficulties declined ● Ownership and the level of asset balances are very important indicators of credit quality ● Credit risk is highly correlated with the level of education achieved by borrower ● Female respondents were significantly more likely to indicate that they had had trouble making debt payments as scheduled ● Renters twice as likely to report having had debt payment difficulties as homeowners ● No relationship between repayment difficulties for debtors with more credit cards and repayment difficulties for debtors with no credit cards
Waller, 1990		X			● Review article that discusses why homeowners choose to default on their mortgages and how lenders can control home mortgage defaults ○ Unemployment and deflation are the main reasons for homeowner financial defaults though unexpected medical events, marital problems, and excessive use of credit are often cited also

Continued.

TABLE 2
(Continued)

Citations	(a)	(b)	(c)	(d)	Key Findings
Wu and Guszczka, 2003		X	X		• Review article that provides evidence for credit score and insurance losses being significantly related ◦ Credit scores explain insurance losses to a good extent • Credit is predictive of insurance loss because it reflects stress, financial planning and organization, and/or degrees of risk taking not measured in other ways
Xiao et al., 2001		X		X	• Family business owners are more risk tolerant and more willing to invest financial assets in risky assets than nonowners • The following characteristics of family business owners had a positive effect on risk-taking attitudes ◦ education ◦ ethnicity (Caucasian) ◦ net worth ◦ and the number of employees in the business • Age had a negative effect on risk taking attitude. Household size and income did not have a significant effect • The following factors were associated significantly with risk taking behavior: ◦ age (0.0021) ◦ Caucasian (0.0996) ◦ homeowner (−0.309) ◦ number of employees (0.02) ◦ number of years of ownership (0.0021) ◦ gross sales (0.031) ◦ who started the business (−0.08) and sole proprietorship (−0.049)

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