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Pay-As-You-Drive insurance (PAYD) where insurance customers can be charged directly for when, where, and how they drive, is now possible thanks to modern telematics technology. PAYD addresses many problems with traditional insurance in terms of more fairly, and transparently, charging users for their driving behaviour and lessens the impacts of insurance on lower socioeconomic groups in particular (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005a; Litman, 2011). Indeed, some estimates of PAYD in the USA have suggested that if it was implemented two thirds of households would benefit, with savings of around $270 USD per car per year (Bordoff & Noel, 2008; Litman, 2011).

However, PAYD insurance does not only have the potential to benefit individuals. Rather, it is estimated to have significant societal impacts, including possible reductions in mileage of up to 8-12% (Adkins, 2004; Balcombe et al., 2004; Bordoff & Noel, 2008; Harvey & Deakin, 1998; Litman, 2005a; Litman, 2011), which could then be associated with accident reductions of 12-18% (Litman, 2011). Furthermore, it is also estimated that even an 8% reduction in mileage would reduce $CO_2$ emissions by 2% and petrol consumption by 4%. This reduction in petrol consumption would be equivalent to the effect of a $1 USD per gallon increase in the price of petrol (Bordoff & Noel, 2008). It is also estimated that PAYD insurance may reduce the profits of insurance companies (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2011). It is therefore recommended that, due to the significant societal gains associated with PAYD insurance, governments examine what they can do to help encourage PAYD insurance despite the potential costs to insurance companies (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2011).

The above estimates are mostly based on economic and transport models and therefore may not completely reflect reality. Assessing the real world impacts of PAYD insurance, however, is difficult as it is a relatively new idea and data on its effectiveness is obviously commercially sensitive. A few research projects have been carried out and have tended to find significant, yet more modest in some cases, impacts of PAYD on driving. These effects have included reductions in speeding in the case of Pay-As-You-Speed additions to PAYD insurance (Bolderdijk, Knockaert, Steg, & Verhoef, 2011; Greaves & Fifer, 2011; Mazureck & van Hattem, 2006), along with reductions in mileage under both Pay-As-You-Speed and mileage based PAYD conditions (Buxbaum, 2006; Greaves & Fifer, 2011). However, one weakness of all of these experimental trials of PAYD insurance is that unlike with real PAYD insurance customers experiment pariticpants never had to pay any costs and could only receive, sometimes very sizable (Greaves & Fifer, 2011), rewards based on their driving behaviour. That participants in experiments cannot be charged is a somewhat unavoidable aspect of experimental research due to ethical concerns and highlights the need for evaluations of commercial PAYD insurance products.

There are many possible types of PAYD insurance. Ranging from pre-paid options where customers pre-purchase a certain number amount of mileage and are then charged based on additional mileage driven, to full behaviour based telematics PAYD insurance where drivers can be rewarded or penalised based on not only how much they drive, but also on where, when, and how they drive (Bordoff & Noel, 2008; Litman, 2005a; Litman, 2011). This, later, behaviour based PAYD can be expected to be the most effective due to its capability to provide richer and more immediate feedback on driver behaviour that is currently sorely lacking in the road environment (Fuller, 1984; Näätänen & Summala, 1974; Rothengatter, 1988; Rothengatter, 2002; Skinner, 1974; Thorndike, 1911; Watson, 1917). This is significant as the earlier provided estimates for the effectiveness of PAYD insurance, due to the well-established link between mileage and accident risk (Bordoff & Noel, 2008; Evans, 2004; Litman, 2011), are mostly based on a simple mileage based charge (Adkins, 2004; Balcombe et al., 2004; Bordoff & Noel, 2008; Harvey & Deakin, 1998; Litman, 2005a; Litman, 2011). Therefore, if more behavioural focused PAYD insurance was introduced, in addition to a mileage based system, the positive impacts on society may be further enhanced.

In terms of behaviour based PAYD insurance there is one promising behavioural candidate. That is acceleration behaviour, which can be taken as an indication of both risky and environmentally unfriendly driving and is relatively easily monitored by modern telematics (Af Wåhlberg, 2008; Barkenbus, 2010). In addition to acceleration, there is also an opportunity to add advisory intelligent speed adaptation (ISA) to telematics based PAYD insurance. Advisory ISA provides warnings to drivers

when they exceed the speed limit. Advisory ISA has been shown to enhance the impacts of PAYD insurance (Lahrmann, Agerholm, Tradisauskas, Berthelsen, & Harms, 2011), as well as having significant speed reducing qualities by themselves (e.g. Brookhuis & de Waard, 1999; Lahrmann et al., 2011; Päätalo, Peltola, & Kallio, 2002; Sundberg, 1999).

Regardless of the type of PAYD insurance, people are likely to have privacy concerns about having their driving monitored, which may reduce their acceptance of PAYD insurance (Bolderdijk, Steg, & Postmes, 2012; Ogden, 2001; Schlag & Teubel, 1997; Schlag & Teubel, 1997; Zweig & Webster, 2002). To minimise these concerns, research suggests that care should be taken to stress the significant individual benefits of PAYD, as people who benefit from a technology are less likely to be concerned about privacy (Bolderdijk, Steg, & Postmes, 2012). Furthermore, if people can be convinced to experience PAYD insurance, for example through a free trial period, privacy concerns may decrease and user acceptance of the system may increase (Buxbaum, 2006). A free trial period may also make customers feel that they should reciprocate this 'generosity' by signing up for PAYD insurance (Cialdini & Goldstein, 2004). Furthermore, framing PAYD insurance in terms of only benefiting drivers by using it to calculate a discount on a future flat rate insurance bill may also help to increase acceptance of PAYD.

PAYD insurance is effectively a delivery system for incentives, i.e. for rewards and penalties. Therefore, it is important that the incentives are structured and presented correctly within any PAYD insurance product to maximise their effectiveness. Both rewards and penalties are effective when behaviour is relatively certain to be rewarded or penalised and when the reward or penalty follows swiftly after the target behaviour. The actual size of the reward or penalty that is received is less important (Bjørnskau & Elvik, 1992; Skinner, 1974; Zaal, 1994). Indeed, in terms of reward size, there is evidence to suggest that instead of directly giving feedback on monetary savings, that points or some other medium could be used. It turns out that individuals are not particularly sensitive to the trade-offs between this medium and the eventual reward (Bagchi & Li, 2011; Hsee, Yu, Zhang, & Zhang, 2003). This means that points could be varied more freely or in larger amounts but trade off to relatively small financial savings while still having a significant impact on driver behaviour. Given the paramount importance of the swiftness of receiving rewards, penalties and feedback (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Lehman, Geller, & Bolderdijk, In Press; Skinner, 1974) it is therefore recommended that feedback on both behaviour and any rewards or penalties is given via an in-car device as part of a PAYD insurance system.

When it comes to rewards versus penalties the advice from psychology is resoundingly clear. Rewards should be used and penalties avoided (Cameron & Pierce, 1994; Gneezy, Meier, & Rey-Biel, 2011; Lattal, 2010; Renner, 1964; Skinner, 1953; Skinner, 1974; Thorndike, 1911; Watson, 1917). Rewards are favoured as they communicate information on what should be done in the future, rather than just saying that someone has done something wrong. Rewards also have the potential to create positive associations between receiving the reward and otherwise somewhat dull tasks, such as driving safely (Bandura, 1986).

That is not to say that rewards have not been criticised, and there is indeed considerable debate about the potentially negative impacts of providing external rewards on individual's intrinsic motivation to perform behaviours (Cameron & Pierce, 1994; Cameron, Banko, & Pierce, 2001; Deci, Koestner, & Ryan, 1999; Deci, Koestner, & Ryan, 2001). The debate about the negative effects of rewards is focused on the controlling aspects of giving rewards and is also focused primarily only on tasks that are interesting and in themselves intrinsically motivating (Deci, 1971; Deci et al., 1999; Deci et al., 2001; Kohn, 1999). Therefore, while the possible demotivating effects of rewards are important to be aware of, they may not apply to PAYD insurance, which essentially aims to reward relatively dull safety related behaviours. Furthermore, many of the negative effects reported typically only hold once a reward is removed or in once off, non-repeated, reward situations (Cameron & Pierce, 1994; Cameron et al., 2001). PAYD insurance, however, is a repeated reward that would essentially always be present unless a customer changed to a non-PAYD insurance plan. Still, care can be taken to further minimise any potential negative impacts of providing external rewards and positive feedback by making sure that

rewards are provided in a non-judgemental and non-controlling fashion (Brehm, 1966; Deci et al., 1999; Deci et al., 2001; Skinner, 1972). Positive feedback on behaviour provided in a non-controlling fashion has been found to actually increase, rather than decrease, intrinsic motivations to perform a behaviour (Cameron & Pierce, 1994; Cameron et al., 2001; Deci et al., 1999; Deci et al., 2001).

There are other ways in which the provision of rewards, penalties, or feedback can be enhanced or behaviour changed in association with PAYD insurance. Firstly, people tend to respond and conform to authority (Cialdini, 2001). However, it is best if this authority is exerted in a soft or expert fashion (Cialdini & Goldstein, 2004). That is to say that authority that comes from someone who has shown that they are credible and capable is more likely to be conformed to than authority that just comes along with a particular position in society. Insurance companies can therefore take advantage of soft authority by demonstrating their own credibility as well as partnering with credible experts when promoting PAYD insurance. However, much like with the provision of rewards care should be taken to not appear controlling when exerting authority (Brehm, 1966; Deci et al., 1999; Deci et al., 2001; Skinner, 1972).

In addition to conforming to authority, people also have a general tendency to conform to others (Cialdini & Goldstein, 2004; Lehman et al., In Press). This tendency to conform is particularly strong if they like (Cialdini, 2001; Cialdini & Goldstein, 2004) and/or perceive that they are similar in some way with the person or organisation that is making the request (Lehman et al., In Press). In terms of PAYD insurance, this can be taken advantage of by providing attractive user interfaces for PAYD systems, good customer service, getting high status people to use PAYD insurance, and by relating to clients via similar beliefs or attitudes. In addition to liking and similarity, people are also likely to conform with others if they believe that other people know something they do not (informative influence) or just to fit in with a crowd (normative influence) (Cialdini & Trost, 1998; Cialdini, 2001; Cialdini & Goldstein, 2004). This tendency to go along with others can be taken advantage of by providing information on what others are doing. However, such information provision can also backfire in that it could signal that a behaviour, e.g. speeding, if done by a majority is in fact acceptable rather than problematic behaviour that needs to change.

In fact, providing information that compares an individual with others has been shown to sometimes result in negative outcomes (Abrahamse et al., 2005; Lehman et al., In Press). For instance when information on average household energy use was provided around a neighbourhood, those who were high energy users decreased their use but those who were low energy users actually increased their energy use (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). The negative effects of comparisons are even stronger if tied to competition elements, which generally speaking appear to only motivate high performers while at the same time demotivating those who do not perceive they can win (Bull, Schotter, & Weigelt, 1987; Dye, 1984). Comparisons and competition within the context of a PAYD system may also raise privacy concerns with customers and therefore reduce acceptance.

In comparison to providing comparisons there is more promise to be had in terms of asking people to make commitments or getting them to set goals for themselves (Cialdini, 2001; Cialdini & Goldstein, 2004; Lehman & Geller, 2004; Lehman et al., In Press). Care should be taken that commitments or goals are set voluntarily and that people do not feel controlled or manipulated. However, assuming that people do choose to make a commitment or goal, say to save money on their insurance, then they are more likely to change their behaviour than people who do not make such commitments (Cialdini, 2001; Cialdini & Goldstein, 2004; Lehman & Geller, 2004; Lehman et al., In Press). This is especially the case if the commitment or goal is made publically (Cialdini & Trost, 1998; Cialdini, 2001), if the individual is provided with prompts (such as a sticker on their car) and feedback (such as from an in-car interface) to remind them of their commitment/goal (Abrahamse et al., 2005; Bagchi & Li, 2011; Lehman & Geller, 2004; Lehman et al., In Press), and if modelling is used to show the individual how they can best meet their commitment or goal (Abrahamse et al., 2005; Bandura, 1967; Lehman et al., In Press).

The way in which a reward or request is framed can also impact its efficacy. In particular, individuals seem more averse to loosing what they already have (Kahneman & Tversky, 1979). This could be taken

advantage of in PAYD insurance by starting people off with already some progress towards a reward, which they may lose if they do not drive in a safe or eco-friendly manner. Another framing effect could be in terms of presenting benefits of PAYD in reference to monetary, safety, or environmental impacts, all of which may have different impacts on how people behave (e.g. Bolderdijk, Steg, Geller, Lehman, & Postmes, 2012; Delhomme, Chappé, Grenier, Pinto, & Martha, 2010). Safety messages in particular may be difficult in terms of informing drivers that they are unsafe. This is because the majority of drivers see themselves as safe and competent (McKenna, Stanier, & Lewis, 1991; McKenna, 1993), therefore, any information they receive to the contrary may put this self-image at risk and lead them to reject or ignore the information.

Many of the above techniques, particularly the addition of rewards and the use of comparisons and competition have recently been rebranded under the heading of gamification (Deterding, Dixon, Khaled, & Nacke, 2011). Gamification is the addition of game design elements to a non-game setting in an effort to increase motivation to perform a non-game activity. Aside from the association with games it is not, however, particularly different from the underlying behavioural and social psychological ideas it rebrands. Plus, as already mentioned the idea of providing comparative data or competition, something that is often done in gamification, appears to carry with it the risk of unintended consequences and demotivation (Abrahamse et al., 2005; Bull et al., 1987; Lehman et al., In Press). Gamification therefore should be treated with care.

Ultimately, PAYD insurance does have the potential to benefit individuals and society (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2011). In particular behaviour based telematic PAYD insurance with in-car feedback fits well with the principles of effective incentives (Fuller, 1984; Näätänen & Summala, 1974; Rothengatter, 1988; Rothengatter, 2002; Skinner, 1974; Thorndike, 1911; Watson, 1917) and if structured and promoted correctly (Cialdini, 2001; Cialdini & Goldstein, 2004; Lehman & Geller, 2004; Lehman et al., In Press) may have even greater impacts than those estimated for purely mileage based PAYD.

# 1. Introduction

This report is the first deliverable of the "Feedback from Pay-As-You-Drive insurance, both outside and inside the car" project commissioned by the Ministry of Infrastructure and the Environment and Univé. The aim of this report is to provide an overview of the literature on Pay-As-You-Drive (PAYD) insurance and its effects. As well as providing an overview of potential ways that rewards, penalties and information can be provided to PAYD insurance customers to encourage them to accept, and increase the effectiveness, of PAYD insurance.

As such, this report has been split into several sections. The first section, section 2, introduces PAYD insurance, looks at the expected impacts of PAYD insurance (section 2.1), provides information on privacy concerns related to PAYD insurance (section 2.2), and gives examples of the different types (section 2.3) and variants of PAYD insurance that are available (sections 2.4 and 2.4.1).

The next section, section 3, goes into the current research on rewards, penalties, and feedback. This section includes information on how to effectively use rewards, penalties, and feedback (section 3.1), whether rewards or penalties should be used and the potential disadvantages of both (sections 3.2 and 3.2.1), and some information on the current use of rewards, penalties, and feedback in the driving environment (section 3.3).

Section 4 of this paper looks at additional persuasive behaviour change techniques other than rewards or penalties. This section includes sections on conforming to authority (section 4.1), conforming to others (section 4.2), comparison and competition (section 4.3), consistency, commitment and goal setting (section 4.4), framing (section 4.5), prompts and modelling (section 4.6), and reciprocity (section 4.7).

Separate from the methods examined in section 4, there is also a small section on gamification (section 5). This section briefly introduces gamification and discusses if it can add anything to the measures already discussed in sections 3 and 4.

Finally, section 6 brings the document together and provides some recommendations for PAYD insurance. In addition some statements about possible directions for future research are made in this section.

# 2. Pay-As-You-Drive (PAYD) insurance

Pay-As-You-Drive (PAYD) insurance is a relatively new model of vehicle insurance where some or all of what customers pay for insurance is based on their individual driving behaviour rather than their aggregate, estimated, risk. The simplest form of PAYD insurance is based on a charge per kilometre driven, i.e. based on a drivers mileage. Mileage based PAYD can be accessed via odometer checks or via more advanced telemetry equipment. However, the basic principle is the same in that those who consume more, i.e. drive more, pay more. The interest in PAYD insurance is in part driven by concerns that traditional insurance methods are unfair and relatively behaviour insensitive (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005a; Litman, 2011). In addition, PAYD insurance is also associated with the general goals of increasing road safety, reducing congestion, and lowering the environmental impacts of road transport (Balcombe et al., 2004; Bordoff & Noel, 2008; Litman, 2011; Zantema, van Amelsfort, Bliemer, & Bovy, 2008).

It may be odd to discuss environmental impacts when talking about a road safety focused measure such as insurance. However, safe and eco-friendly driving are very closely associated, with many of the driving behaviours that are considered safe also being related to driving in an environmental friendly fashion. For instance driving less, driving at consistent low speeds, not rapidly accelerating or braking, and driving in a proactive rather than reactive fashion all have positive safety impacts as well as being eco-friendly (Barkenbus, 2010). Therefore if PAYD insurance can impact on safety it will also have flow on effects to environmental impacts and congestion, which could perhaps also be used to promote PAYD insurance.

Under traditional insurance there is some stratification of clients based on their 'risk profile'. This generally includes factors such as what car they are driving, where they live, and their age. However, once placed in a broad category everyone in that category pays pretty much the same no matter their income, how much they drive, or how safely they drive. This aggreation has adverse effects on people who, based on aggregate information, are classified as 'high risk', but who based on their own individual driving would be seen as 'low risk'. It is also claimed that traditional insurance is particularly unfair to low income individuals who are often classified into 'high risk' insurance categories based on where they live (urban areas), due to the older, and therefore less crashworthy, types of cars they drive, and sometimes based on their age (young people tend to have less income) (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005a; Litman, 2011). However, low income individuals also tend to drive less than high income individuals (due to the cost of fuel), which lowers their accident risk. At the same time those with a lower income are much less able to afford insurance. In fact, car insurance is often one of the largest single costs facing low income families (Adkins, 2004; Litman, 2011). High insurance costs can lead to those with low income driving without insurance, which places extra costs on society in the case of an accident. In fact, the proportion of uninsured vehicles in US low income communities is estimated to be as high as 50% (Hunstad, 1999). The high cost of insurance can also lead low income individuals to decide to not purchase a vehicle in the first place and limits their access to employment and other opportunities (Adkins, 2004; Litman, 2011). Therefore, a move to a fairer, PAYD insurance, type system where individuals are charged for how much and the way they drive would give low income individuals more control over their insurance bills and make owning a vehicle more affordable. Furthermore, since low income individuals have fewer resources they are also likely to be more responsive to the changes of insurance costs under a PAYD system and therefore be motivated to drive in a safe and eco-friendly manner (Litman, 2011).

The traditional, flat rate, approach to insurance has also been compared to all you can eat restaurants (Litman, 2011) or cell phone plans (Litman, 2005a). With the argument being that paying a flat rate, rather than for how much you use, leads to increases in consumption. In the case of an all you can eat restaurant that means eating more, or more calling on a cell phone plan, or in the case of insurance, an increase in driving. Since driving more is related to accident risk, congestion, and environmental impacts it is therefore suggested that the current method of insurance actually encourages and supports unsafe, inefficient, and environmentally damaging behaviour (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005; Litman, 2011). Economists in particular refer to the 'externalities' that traditional insurance creates. By 'externalities' economists refer to the additional costs associated with a transaction that are not

directly born by the consumer or the seller (Edlin, 2008). In the case of traditional insurance the full externalities of driving, in terms of the impact on safety, congestion, and the environment are not currently well addressed and therefore the prices in the market do not reflect the true cost of driving and in fact underestimate it. As such, according to economic theory, this lack of true price signals will also encourage driving and therefore have negative societal impacts. While drivers do not often operate under the price sensitive utility maximisation that would support the economic view on driving (Rothengatter, 2002), PAYD insurance does have the potential to internalise some of these otherwise external costs and make them more apparent to drivers, which may in turn influence their driving behaviour.

In addition to these larger scale economic externalities, driving at an individual level is quite forgiving of risky behaviour (Evans, 2004; Fuller, 1984; Näätänen & Summala, 1974). This means that unsafe driving behaviour can be performed on a regular basis with no negative consequence and perhaps even without the driver's awareness that what they are doing is unsafe (Fuller, 1984; Lewis-Evans & Charlton, 2006; Lewis-Evans, de Waard, Jolij, & Brookhuis, 2012; Näätänen & Summala, 1974). Another troublesome factor is that safe behaviours, such as driving at safe speeds or maintaining good following distances, can be punished by time delays or boredom during every day driving. Whereas objectively risky behaviour such as speeding is rewarded not only by gains in time, but also by the pleasurable sensations associated with speed, and the social approval of peers (OECD-ECMT, 2006b; Rothengatter, 1988). PAYD insurance therefore opens the opportunity to offer rewards to safe drivers and make the costs of driving in a risky fashion more immediate and clear.

Related to the externalities discussed above it is also argued that traditional insurance is unfair to most insurance customers (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005a; Litman, 2011). In short, the high risks of certain individuals are never fully covered by traditional car insurance, as it would mean pricing insurance much too high for these high risk individuals. This means that the costs of the claims that high risk individuals generate must be spread across other, less risky, clients effectively driving up the cost of their insurance despite their relatively safer, and therefore also more eco-friendly, driving behaviour. PAYD insurance addresses this issue by more directly charging individuals for their own driving behaviour. That is not to say that group factors would not pay a part in a PAYD system as these factors are still safety critical and therefore important in order to establish a fair PAYD insurance rate. For example a PAYD driver in an urban area, where there tend to be more accidents per kilometre travelled, should pay more per kilometre driven than a PAYD driver on a dual carriageway. Similarly, other aggregate risk factors, such as age, gender, or driving at night, can be taken into account as modifiers on the base rate of PAYD insurance. Although, it should be noted that basing insurance charges on gender has recently been ruled as illegal under European law and this is likely to also apply to PAYD insurance (InfoCuria). However, a driver behaviour, rather than mileage, based PAYD system could address the issues of high speed and unsafe accelerations that are typically associated with male drivers (OECD-ECMT, 2006b) without the need to specifically target them.

As mentioned earlier the most common form of PAYD is mileage based, where drivers pay a fee per kilometre or mile driven. This is due to the well-established relationship between mileage, accident rates, and environmental impacts (Bordoff & Noel, 2008; Evans, 2004; Litman, 2011). The relationship between mileage and accident risk is particularly robust and is often presented in terms of a linear relationship between driving more and the risk of being involved in an accident. This is not completely accurate, however, as the true relationship between accident risk and mileage is somewhat non-linear (Bordoff & Noel, 2008; Evans, 2004; Litman, 2005a; Litman, 2011). The non-linear nature of the mileage-safety relationship is due to several factors such as; the relatively rare Poisson distribution of accidents, that older motorists or those with disabilities tend to drive less, yet have a greater risk of being hurt in an accident, that high mileage drivers have more driving experience and therefore are relatively more competent, that newer and therefore safer vehicles tend to be driven further, whereas older, less safe, vehicles tend to have lower mileages, and that high mileage driving is more often done on relatively safe separated highways whereas low mileage driving is often carried out in relatively risky urban environments (Bordoff & Noel, 2008; Evans, 2004; Litman, 2005a; Litman, 2011). As mentioned

above, it is important to take the above factors into account when deciding on a per kilometre charge for PAYD insurance. However, despite this non-linear relationship the rule that if mileage increases so does accident risk can still be generally applied. So even if a high mileage driver is somewhat safer due to their experience, it is still generally true that if they drive more their risk of being in an accident will increase. It should also be noted that if a road user drives less then this has flow on effects to other road users who are now also, generally speaking, less at risk due to reduced traffic flows. These wider societal impacts of reduced mileage are difficult to reflect in PAYD charges, yet it certainly impacts on the wider benefits that PAYD insurance could provide for society (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005a; Litman, 2011).

## 2.1 The effects of PAYD insurance



While PAYD insurance is offered by several providers around the world (see section 2.3 for examples) they are being operated by commercial entities and therefore information on their effectiveness is often commercially sensitive and not widely available. However, in terms of mileage reduction, mileage based PAYD insurance has been estimated by researchers to reduce vehicle travel by 8-12% (Adkins, 2004; Balcombe et al., 2004; Bordoff & Noel, 2008; Harvey & Deakin, 1998; Litman, 2005a; Litman, 2011). These estimates are dependent, however, on assumptions made about how much PAYD insurance would cost and how the product would be structured. For example Litman (2011) states that a 4 cent (USD) per mile fee would reduce vehicle travel by 10%. Whereas others have estimated that a 6.5 cent (USD) per mile fee would reduce travel by 10-12% (Balcombe et al., 2004; Harvey & Deakin, 1998).

Assuming that the estimated drops in mileage are correct then the safety benefits of PAYD insurance are large. With a 10% drop in mileage also estimated to result in a 12-18% reduction in accidents (Litman, 2011). Even if the smaller estimate of only an 8% mileage reduction made by Bordoff & Noel (2008) is taken into account and applied to the whole population of the USA it would result in an estimated reduction of $50-60 billion USD in driving related harms, a reduction of $CO_2$ emissions by 2%, and a reduction in petrol consumption by 4%. To put this estimated 4% reduction in petrol consumption into perspective, it is also estimated that it would take a $1 USD increase in the price of petrol per gallon to produce the same effect. In addition to the direct environmental impacts the reduction in petrol consumption would also have socio-political impacts in terms of the power of oil producing countries (Bordoff & Noel, 2008).

Not all estimates of the impact of PAYD insurance have been as positive. For example, one study in the Netherlands has estimated that a voluntary flat cost 4 euro cent per kilometre PAYD system would only result in a 1% reduction in accidents, and an approximately 2.5% decrease in average travel times (Zantema et al., 2008). The same study estimated that a government mandated PAYD insurance system with road (0.6 euro cents per kilometre on the motorway, 2.2 euro cents per kilometre on an interurban roads, and 11.2 euro cents per kilometre on urban roads) and night-time (an 1.7 euro cent modifier on rates between 7pm to 7am) differentiated charging would result in a 5.7% reduction in accidents but would also result in a 0.6% increase in travel times. The increase in travel times was estimated to occur due to a shift by drivers towards motorways, which are cheaper and safer, but could result in more congestion.

In addition to the benefits to society mentioned above, more direct influences on individual insurance customers have also been estimated. Specifically it is thought that if PAYD was implemented in the USA then the two thirds of households would benefit and be able to save approximately $270 USD per vehicle, per year (Bordoff & Noel, 2008; Litman, 2011). This saving would benefit many lower income families in particular.

PAYD insurance would also impact on the insurance companies themselves. Again, information on the real world impacts of PAYD on insurance companies is not easily accessible due to commercial sensitivities. However, Desyllas and Sako (2012) report that a GPS based PAYD insurance program

would reduce loss ratios by 20%, primarily due to the safer driving of clients, a reduction in inaccurate or fraudulent claims, and the fact that GPS based PAYD insurance can also be helpful in theft prevention and vehicle recovery. Furthermore, a study looking at Progressive Insurance in the US concluded that PAYD insurance helped build closer customer ties between the insurance provider and clients via an increased sense of fairness, the provision of transparent prices, and an increased sense of security (Desyllas & Sako, 2012). It is also assumed that an attractive PAYD product, especially one that gets onto the market early, would attract customers that usually cannot afford insurance, occasional drivers that are well served by public transport, cautious drivers with 'high risk' aggregate profiles (i.e. some young drivers), fleet owners, and people with young drivers or older parents that want the extra sense of security that comes with the monitoring of driver behaviour associated with PAYD insurance (Bordoff & Noel, 2008; Desyllas & Sako, 2012). The types of customers listed previously may even switch from other insurance companies in order to get the benefits of a good PAYD package, especially if the benefits of PAYD insurance are made clear to them via marketing messages. That PAYD insurance may be attractive to the parents of young drivers and to cautious young drivers themselves is important as young drivers have a high accident risk profile (OECD-ECMT, 2006b). Therefore, if PAYD insurance can help young drivers learn to drive safely it may help form habits that last a lifetime. However, if this is the case it is crucial that young drivers are enrolled in a PAYD insurance program while they are learning and during the first 6 months that they begin to drive solo. This is important as this first 6 months is the time at which young drivers are most likely to be involved in an accident and is also likely a time of intense learning and habit formation (Groeger, 2006; Lewis-Evans, 2010; OECD-ECMT, 2006b).

The estimates of the impact of PAYD on insurance companies are not all positive. As mentioned previously it is estimated that two thirds of insurance customers in the US would be better off under a mileage based PAYD system (Bordoff & Noel, 2008; Litman, 2011). This means they would be paying less, which also means that insurance companies in general would be taking in less money. In fact, Bordoff & Noel (2008) estimate that under a best case scenario mileage based PAYD would only save insurance companies $34 USD a year per vehicle that switched. Adkins (2004) has also estimated the impact of PAYD on insurance companies and concluded that the introduction of PAYD would inevitably lead to drops in profits and that it would also hurt the investment strategies of insurance companies due to them no longer being able to rely on the steady and predictable income flow that is associated with traditional car insurance. Furthermore, since it is likely that high mileage and high risk customers will stay on flat rate insurance. The claim costs for traditional insurance may increase. This could be compensated by increasing the cost of flat rate insurance, further incentivising a move to PAYD insurance; however, it may also hurt insurance companies, at least in the short term. Finally, the setup and maintenance of the infrastructure for PAYD insurance, particularly if it is GPS monitoring based, is a considerable cost that would have to be taken into account and met by insurance companies. Given these costs to insurance companies and the large potential social benefits of PAYD insurance in accident reduction, environmental protection, and road congestion there are calls by advocates of PAYD for Governments to step in to help insurance companies with the costs outlined above (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005a; Litman, 2011).

The above estimates of the costs and benefits of PAYD have generally been produced by economists and transport planners who make assumptions about how reactive drivers will be to hypothetical PAYD insurance systems. It is, however, also useful to look at large on-road studies that have assessed PAYD insurance systems and see what behavioural changes have occurred. One such study was carried out in the Netherlands by Bolderdijk, Knockaert, Steg & Verhoef (2011) who found no impact of PAYD on the mileage of drivers. This is not good news for mileage focused PAYD insurance. However, in the case of the Bolderdijk, et al (2011) study the lack of effect can possibly be explained by the fact that the PAYD insurance system used was not a standard mileage based one. In fact, the majority of the emphasis of the PAYD system was put on reducing speeding behaviour with 30 euro of the potential 50 euro incentive being assigned to rewarding keeping to the speed limit and only 15 euro able to be gained through reducing mileage. Since speeding behaviour is more directly and immediately under drivers moment to moment control they may have opted to focus on getting their reward via this channel and

therefore avoided the relatively more difficult task of adjusting their mileage. The end result was about a 4% reduction in the amount of time spent voluntary speeding. This reduction in speeding may sound small but it is in fact quite significant with the OCED/EMCT (2006a) estimating that as small as a 5% reduction in speeding in the driving population could decrease fatal accidents by 20%. A similar 'Pay-As-You-Speed' system was also examined in Australia and resulted in a reduction in mileage of 10% and a 4.7% reduction in the proportion of distance spent speeding (Greaves & Fifer, 2011). However, it should be noted that in the case of the Greaves and Fifer (2011) study the potential financial gains were higher than those in the Bolderdijk et al. (2011) study, with an average pay out to participants of $116 AUD. Also in the case of the Greaves and Fifer (2011) study speeding was used as a modifier that changed the baseline price per kilometre travelled rather than being a separate incentive. Treating speeding as a modifier on top of the normal mileage based charge may have made drivers more sensitive to their mileage than in the Bolderijk et al. (2011) study.

The Belonitor trial, which was carried out in the Netherlands, is another example of a behaviour based PAYD system (Mazureck & van Hattem, 2006). The Belonitor system rewarded drivers if they stayed under the speed limit and did not follow cars in front of them too closely. Feedback on which was provided to the drivers via the in-car interface shown in figure 2.1


Figure 2.1 The in-car interface used in Mazureck & van Hattem (2006) to provide feedback on close following and speeding.

In the Belonitor study points were awarded with a trade-in value of between 0.04 and 0.01 euro per point and had to be checked via a website. Points were only awarded if both speed and following behaviour was appropriate (below the speed limit and more than 1.3 seconds behind a lead vehicle) and were given at a rate of one point per 15 seconds. There was also a chance to win an overall 500 euros prize. The results of the study were that there was a significant increase in the proportion of kilometres spent driving under the speed limit, from 68% to 86%, along with an increase in the kilometres spent following vehicles at greater than 1.3 seconds head way, from 58% to 77%. Based on these results Mazureck & van Hattem (2006) estimated that if all vehicles in the Netherlands had a Belonitor system road accident fatalities would decrease by 15% and injuries by 9%.

The three studies above are alterations to the basic mileage based Pay-As-You-Drive insurance formula. In contrast, research by Buxbaum (2006) looked at a traditional mileage based PAYD insurance system in the USA. Buxbaum (2006) examined a PAYD system that involved drivers attaching a device to their vehicle that would then record their driving behaviour. Then once the device was returned the data on their mileage could be used to calculate how much their driving would cost them. The overall result of this trial was a 4.4% reduction in mileage, with an 8.1% reduction in trips on the weekend and a 6.6% reduction in weekday peak time mileage. However, some drivers in the study actually increased their mileage during the PAYD insurance period. These individuals tended to live in areas without public transport options, had only one vehicle in their household, had a college-graduate or post-graduate as the head of their house, and shared the PAYD vehicle between one or more household members which made it harder for them to co-ordinate its use. Conversely, those who did decrease their mileage tended to have leased vehicles, meaning they might be used to monitoring mileage already, had household members who 'actively think about car ownership', and also tended to have another vehicle in the household that could be used instead of the one that had PAYD installed. This last fact that participants could shift to drive another non-charged vehicle is a serious flaw with this

study and means that its results should be interpreted with care.

While it is always preferable to get data from on-road behavioural results, such as those reported above, rather than estimates it should be noted that there is one major limitation to the experimental studies mentioned. In all three cases, due to ethical concerns and the need to recruit participants, the participants could only loose a potential reward based on their driving and once this reward was gone they were not charged for any subsequent driving. Under a real PAYD insurance system participants would be rewarded for good behaviour, however this would tend to take the form of a reduction in the amount they still had to pay, meaning that there would always still be a cost to the driver. Therefore, the fact that the participants in these experiments never actually had to pay anything for their driving behaviour no matter how they drove may have lessened the impact of the PAYD intervention. That participants in experiments cannot be charged is a somewhat unavoidable aspect of experimental research due to ethical concerns and highlights the need for evaluations of commercial PAYD insurance products.

One final thing should be mentioned in terms of a potential impact of PAYD insurance and that is the potential for negative behavioural adaptation and technological over reliance (OECD, 1990). Negative behavioural adaptation is when people respond to a new technology or intervention in a way that is against or opposite to what is intended, and in the case of road safety negative behaviour adaptation may reduce or remove safety benefits of interventions (Carsten, 2009; Fuller, 1984; Näätänen & Summala, 1974; OECD, 1990; Vaa, 2007; Wilde, 1976). So, for example if a road is widened people may speed up when driving on it, therefore reducing the safety effects of the wider road (Lewis-Evans & Charlton, 2006). One type of negative behavioural adaptation that is likely to occur with PAYD insurance, particularly if it is in-car feedback based, is technological over-reliance, also known as complacency (Parasuraman & Riley, 1997).This is where people accept a new technology and come to rely on it too much meaning that if it fails or provides incorrect information there may be negative outcomes (e.g. Rudin-Brown & Parker, 2004). So, for example if a car had a forward collision warning people may start driving closer to the cars in front of them, relying on the system to warn them if anything goes wrong. Another example would be blindly trusting a GPS system and ending up lost or trying to turn into a road that does not exist. At this time, however, there is no indication of such negative behavioural adaptation to PAYD insurance that we are aware of. But, it is always a risk and care should be taken to detect it, and correct it, if it occurs.

## 2.2 Privacy concerns and the acceptance of PAYD insurance

One impact of PAYD insurance that is not mentioned in Section 2.1 is its impact on privacy. Telematics based PAYD insurance in particular has a large potential impact on privacy as it involves the monitoring of when, where, and how vehicles are being used. However, all PAYD insurance requires that a certain amount of private information is monitored, and indeed that this behaviour is being monitored is part of what is expected to produce behaviour change (Bolderdijk et al., 2011). However, at the same time consumers may feel that their privacy is being invaded and therefore may not wish to engage with PAYD insurance (Bolderdijk, Steg, & Postmes, 2012; Ogden, 2001; Schlag & Teubel, 1997; Schlag & Teubel, 1997; Zweig & Webster, 2002).

The problem of PAYD insurance and privacy can be illustrated via the history of telematics based PAYD insurance at the US insurance company Progressive. Their first telematics PAYD insurance package was the 'Autograph' system that was introduced by in 1998 and was eventually discontinued because of its high cost but also in part because customers saw the tracking system as an invasion of their privacy (Desyllas & Sako, 2012). Progressive then started offering the 'Trip-sense' PAYD product in 2003. 'Trip-sense' was based on a device that was plugged into the vehicle and had to be manually uploaded in order to share the data the device had collected. Also, data on where a customer had been driving was not collected as it had been with the 'Autograph' system. The lack of location data and the choice to upload the data being in the hands of the customer appears to have lessened privacy concerns.

However, in 2009 Progressive replaced 'Trip-sense' with the 'MyRate' product. 'MyRate' returned to the constant monitoring and transmission of driver data that had been present with 'Autograph'. It appears that the live transmission of data again increased privacy concerns and more recently, in 2010, the 'Snapshot' system replaced 'MyRate'. The 'Snapshot' system monitors a driver's behaviour via a device plugged into a car's diagnostic port. This data is wirelessly transmitted to Progressive and tracks mileage, fast acceleration, hard braking, cornering, and the time of day. The 'Snapshot' system is initially used for 30 days to give up to a 30% discount on the next 6-months of insurance costs. After 6-months the data from 'Snapshot' is again used to change this discount amount. Privacy concerns about 'Snapshot' have been reported as lower than 'MyRate' by Desyllas & Sako (2012), and this could be related to no longer collecting data on speed or to the time-period based assessment method. Progressive also provides clear data guidance that all information collected is on a voluntary basis and will never be passed on to the police or the government. However, it may also be that attitudes towards privacy are changing over time and that people have become more trusting and accepting of the privacy trade-offs required by many modern technologies (Bolderdijk, Steg, & Postmes, 2012; Buxbaum, 2006).

Given the above, privacy is an issue that any insurance provider or any government looking to encourage, or institute compulsory, PAYD insurance should consider. In relation to the privacy issue, research has suggested that if people perceive that they will gain a benefit by giving up information that would otherwise be private then they are much less reluctant to do so (Bolderdijk, Steg, & Postmes, 2012). This applies generally, but the Bolderdijk, Steg, & Postmes (2012) study also included one experiment (experiment 2) that focused on privacy concerns related to a hypothetical PAYD insurance product. In this experiment, 23 participants read a positive assessment of PAYD insurance which told them that:

> "The less you drive, the less likely it is that you will be involved in an accident, and the more you save on your premium." Additionally, participants in the positive policy consequences condition read, "Imagine that over the course of a year, you've reduced your mileage by 20%. This means you would save €200 on your insurance premium." (Bolderdijk, Steg, & Postmes, 2012, pg 7)

Whereas, 27 participants read a more negative assessment of the impact of PAYD insurance and which told them that:

> "The more you drive, the more likely it is that you will be involved in an accident, and the more additional premium you have to pay."… Additionally, participants in the negative consequences condition read, "Imagine that, over the course of a year, you've increased your mileage by 20%. This means you would have to pay an additional insurance premium of € 200." (Bolderdijk, Steg, & Postmes, 2012, pg 7)

Those participants who read the negatively framed assessment of PAYD insurance rated it significantly more concerning in terms of privacy (with an average rating of 4.52 out of 7) than those who read the positively framed assessment (with an average rating of 3.31 out of 7). So, given that mileage based PAYD insurance is estimated to benefit approximately two-thirds of drivers (Bordoff & Noel, 2008; Litman, 2011), privacy may only be a large issue for the third of consumers who would not benefit under such a system. However, in the case of voluntary PAYD insurance such non-benefiting customers would probably not be attracted to PAYD insurance in the first place. Nor would they necessarily stick with such a system once they find out that they are not benefiting. An initial, obligation free, trial period for a PAYD insurance product, such as that used by the 'MyRate' package (Desyllas & Sako, 2012) would likely help customers determine if they will benefit or not from PAYD and therefore lesson privacy concerns. Along with having the added value of demonstrating the benefit of PAYD to those who would gain from such a system. Evidence that a trial period of PAYD insurance can reduce privacy concerns comes from a study carried out by Buxbaum (2006). In this study the participants who had

experienced PAYD insurance were significantly more accepting of the technology and less concerned about their privacy than those in the control group who had not experienced PAYD insurance. This effect, where experience with a new product, technology, or policy increases acceptance for it, is well known (for example see Schuitema, 2010) and highlights the importance of trial periods, as well as the fact that care should be taken when making decisions about not implementing a new technology just because acceptance levels amongst those who have not tried it yet appears to be initially low.

In terms of a voluntary PAYD insurance program it should be remembered that many of the estimates of the large societal benefits associated with mileage based PAYD insurance do assume that people who do not benefit from PAYD are still having their behaviour affected by PAYD (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005a; Litman, 2005b; Litman, 2011; Zantema et al., 2008). This means that if it is easy for those who do not benefit to remove themselves from PAYD insurance systems then the impact of PAYD on society is likely to be reduced. For example, a previously mentioned study in the Netherlands estimated that the impact of voluntary mileage based PAYD insurance (where non-benefiting drivers would presumably not sign-up), with modifiers for type of road and time of day, would reduce accidents by 2.5%. Whereas compulsory government mandated PAYD would more than double the benefits and reduce accidents by 5.7% (Zantema et al., 2008).

The privacy concerns that individuals may have about PAYD insurance are also likely to depend on how the insurance is structured. For instance is it a system where drivers can actually end up paying more than they currently do? Or does the system only use driver behaviour to calculate a discount that is then applied to a set price for insurance, meaning that drivers would not have to pay over a set maximum? This latter, discount only, version of PAYD may be more acceptable to customers as it creates an impression that there is only benefit to be had. Although it is not known if this discount approach would have a greater or lesser impact on driver behaviour than has been previously estimated, as these previous estimates have the assumption that insurance costs are directly tied to mileage (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005a; Litman, 2005b; Litman, 2011; Zantema et al., 2008). A discount based PAYD system would also allow for more accurate estimating of future revenue streams by insurance companies as they would always be able to guarantee a set minimal amount of payment from customers. That an insurance company could use this information to better estimate income would then also reduce the potential negative fanatical impacts of PAYD (Adkins, 2004; Bordoff & Noel, 2008).

While privacy is obviously important for the acceptance of PAYD insurance there are also likely other factors that will impact on whether it is attractive to drivers. These could range from purely a cost-benefit analysis to the impacts how the data on their driving behaviour is presented to them. While, to the best of our knowledge, these specific factors have not been publically investigated, a couple of studies have examined the general acceptance of PAYD insurance. Bordoff and Noel (2008) for example state that 9 out of 10 people who answered a survey in the UK would prefer that their insurance was reflective of the way that they used their car and the journeys that they made. Furthermore, of those surveyed, half of them favoured a PAYD insurance plan where you pay every month based on your car usage like a gas or electricity bill. Another study, carried out in the Netherlands, used a stated preference design and found that for a monthly reward of around 7-8 euros that 27% of the participants indicated that they would be willing to try PAYD insurance. Interestingly this figure of around 27% did not really change along with increases in the potential reward amount. Rather, the best predictors of interest in PAYD insurance seemed to be if people were unhappy with their current insurance or if they liked the idea of PAYD insurance. There was also a slight bias in female respondents towards favouring PAYD insurance (Knoop, Li, & van Arem, 2011). This 27% figure matches well with the fact that Progressive insurance, mentioned above, also had around 34% its customers in Michigan, Minnesota, and Oregon using a their PAYD insurance product in 2004 (Bordoff & Noel, 2008).

## 2.3 Types of PAYD insurance and examples

There are several forms of PAYD insurance. The first is perhaps the most simple and can be compared to a pre-pay cell phone contract. Under this most basic PAYD system customers pre-purchase insurance based on their expected mileage for a period (for example a year) and then are assessed at the end of that period and either reimbursed or charged extra if they have exceeded the previously agreed upon mileage. The mileage checks and reporting can be carried out either by the individual drivers, which carries with it a higher risk of fraud, or via independent assessment of odometers or in-car monitoring devices. Such a pre-paid system could also be configured so that drivers could 'top up' their mileage limits as they exceeded them. One such system is being operated by Real Insurance in Australia (Litman, 2011). Pre-paid mileage systems are limited in terms of a relatively high possibility of fraud and that they are only sensitive to how much the customer has driven and not necessarily where, when, and how they drove.

The next PAYD insurance variation is similar to the above but rather than prepaying for mileage customers are regularly assessed. Again this assessment can occur by themselves, by external assessors, or via technology (i.e. devices that collect mileage and are regularly uploaded or sent back to the insurance company), and then charged based on their current car usage. This form of PAYD insurance involves less of an up-front payment to the insurance company and provides a greater and more immediate level of feedback on the cost of their driving which may lead them to be more sensitive to these costs and change their behaviour more rapidly than the pre-paid method of consumption (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2005a; Litman, 2005b; Litman, 2011; Mazureck & van Hattem, 2006; Skinner, 1974; Zantema et al., 2008). If monitored via technology, this type of approach also allows for information like where and when the customer was driving to be taken into account and factored into PAYD charges.

The rate of feedback to the driver can then be further enhanced via constant monitoring PAYD systems. Such systems rely on in car technology, such as a GPS system, to monitor driver behaviour and send this information in real time back to the insurance company. This not only allows for how much, when, and where driving occurs to be taken into account in PAYD insurance charges, but also opens the possibility for driver behaviour to be monitored and priced. Furthermore, in car technology gives added value to drivers in terms of also being able to be linked to 'black box' type functions in the case of an accident and to anti-theft or vehicle recovery measures. This type of constant monitoring system also opens the possibility for detailed information to be feedback to drivers either in real time in the car or at a later date via a the internet or postal service. Constant monitoring is also the most expensive option but is predicted to have the greatest benefit due to being able to more accurately reflect rewards for good driving behaviour and the general responsiveness of humans to more direct monitoring and feedback (Lattal, 2010; Renner, 1964; Thorndike, 1911; Watson, 1917).

As mentioned in the section on privacy (Section 2.2), one option for PAYD insurance is to use the data collected to offer a discount off a future lump sum insurance payment rather than setting the insurance directly via a mechanism such as being charged a certain amount per unit travelled. This creates the impression that the customer is earning or losing a discount and also reassures customers that their driving behaviour will never be used to charge them more than the standard flat rate. Such a discount approach could be used with any of the types of PAYD insurance discussed above.

Several companies around the world already offer PAYD insurance packages of varying types. Below are a few examples:

### Allstate (USA)

http://www.allstate.com/drive-wise.aspx

Allstate offer the 'Drive Wise' system which is a telematics option that records mileage, speeding, night-time driving (between 11pm and 4am weekdays and 11pm to 5am weekends) and braking behaviour. The data collected by 'Drive Wise' is then used to calculate a discount on insurance renewal using 12 months (6 months at the first renewal) of rolling data. Clients can also check on

their progress and get feedback on their driving via a web interface.

### American Family Mutual Insurance (USA)

http://www.amfam.com/microsites/teen-safe-driver/default.asp

The 'Teen Safe' driver package is a young driver behaviour based PAYD system. It monitors young driver behaviour and provides a year of professional coaching to the young driver based on that behaviour.

### Co-operative Insurance (UK)

http://www.co-operativeinsurance.co.uk/servlet/Satellite/1228203835143,CFSweb/Page/Insurance-Car?WT.mc_id=Ins_Banner2_YDIns

This is a behaviour based telematics PAYD package aimed at young drivers. It monitors their braking, acceleration, cornering, speeding and the time of day at which they drive. The behavioural data is then used to provide 'safe driver' discounts and feedback to drivers via a web interface (see figure 1.2).

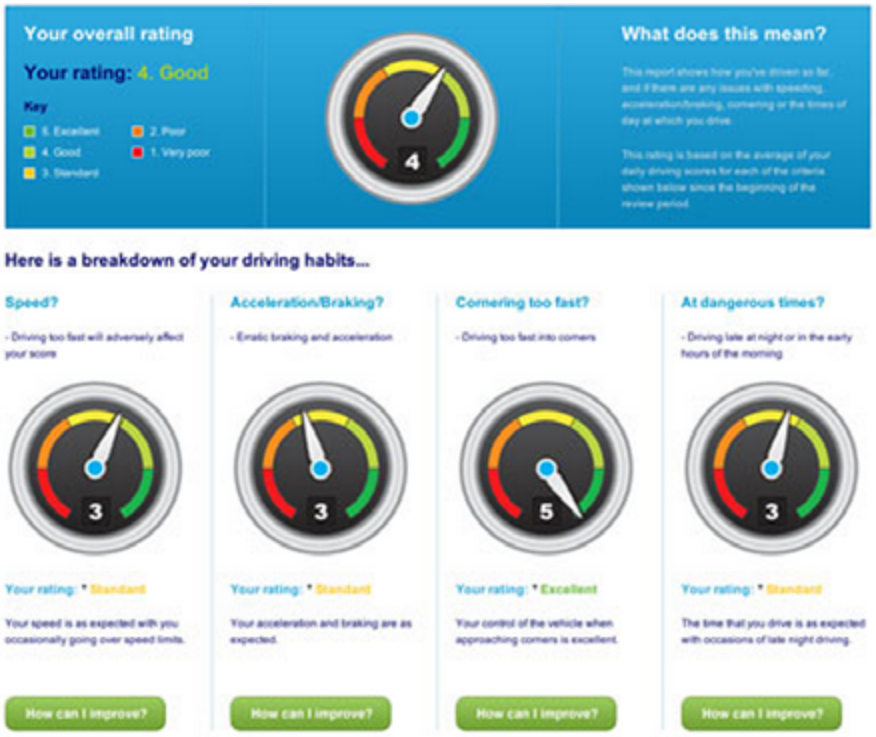


Figure 2.2 Co-operative insurance's driver feedback web interface.

### GMAC insurance (USA)

https://www.gmacinsurance.com/auto-insurance/smart-discounts/low-mileage-discount.asp

A 'Pay-As-You-Go'[1] mileage based PAYD insurance system that uses GPS technology to provide a discount on a flat rate insurance bill based on how many miles a customer drives. This mileage is confirmed via a telematics system. However, no other data is collected. That no additional data is collected is presented by GMAC as a selling point.

### iKube (UK)

http://www.ikubeinsurance.com/

'iKube' is a young driver focused product and the company claims they are a specialist in 'learner driver insurance'. They offer variety of telematics based insurances. All of which appear to offer the ability for young drivers to earn 'cheaper premiums' by not driving between 11pm – 5am. They also promote that they '… won't charge you per mile, unlike other providers'.

1 It is worth noting that in the USA both 'Pay-As-You-Drive' and 'PAYD' are trademarks of the Progressive insurance company. This means that other companies in the USA must use different terms for their packages. However, Progressive was denied this trademark (and its associated patents) in Europe (Desyllasa & Sako, 2012)

### Ingenie (UK)

http://www.ingenie.com/

Ingenie offers 'black box' insurance to young drivers. This insurance package uses telematics to collect data on acceleration, braking, speed, cornering, and swerving. This data is then feedback to drivers via the web or an app and used it to calculate a discount on insurance costs based on a renewal every 3 months. Ingenie do not charge by the mile and do not take time of day of driving into account. Indeed, they use the fact they do not have any 'curfew's' in their marketing material.

### Insure the Box (UK)

http://www.insurethebox.com/

'Insure the box' markets itself as 'The UK's leading telematics insurer'. Their system first involves drivers pre-purchasing either 6,000 or 8,000 miles. Each driver's mileage is then tracked via an in-car system and drivers can then 'top-up' these miles at any time by purchasing more. In addition to this pre-paid mileage, driver behaviour is tracked and they can earn 'bonus' miles (up to 100 miles per month) as well as receiving a discount at the time of next insurance renewal. It is not exactly clear how bonus miles and this discount are earned, but they seem to be based on the monitoring of; time of day, speed by road type, smoothness of driving, taking breaks on long journeys, type of road driven, number of journey's made, and the details of any accidents. It is also possible for drivers to view information on their driving online and get 'reward miles' by shopping online with retailers that are associated with 'Insure the Box'. 'Insure the box' also heavily promote themselves as offering 'incentives not penalties' and that they have 'no curfews or fines'. In addition to the PAYD insurance package 'Insure the Box' also uses their telematics system to offer car theft recovery and automatic accident reporting.

### Liberty Mutual (USA)

https://www.onboardadvisor.com/

The 'Onboard Advisor' product is telematics based and focused on fleet owners. It provides discounts and along with web and mobile application based analysis and feedback on what it calls 'driving style' and speeding behaviours.

### Progressive insurance (USA)

http://www.progressive.com/auto/snapshot.aspx

Progressive are pioneers in PAYD insurance and their latest package is called 'Snapshot' (Desyllas & Sako, 2012). The snapshot system uses a telematics device that is plugged into a cars diagnostic port and provides a discount based on drivers braking behaviour, mileage, and their frequency of driving between midnight and four am. The device does not, however, record how fast or where you drive.

### Real Insurance (Australia)

www.payasyoudrive.com.au

An odometer check based pre-paid PAYD insurance system where customers can pre-buy mileage at any time. This includes the ability to 'top up' their mileage allowance if they exceed it.

### Statefarm (USA)

http://www.statefarm.com/insurance/auto_insurance/drive-safe-save/drive-safe-save.asp

The 'Drive safe and save' product uses telematics based information on mileage and acceleration data to provide a discount on insurance. This is based on driver behaviour collected over 6 months of driving that is then used to set a discount on insurance for the next insurance policy period.

### Teensurance (USA)

https://www.teensurance.com/

While not strictly a PAYD insurance product, 'SafeCo' from Teensurance demonstrates young driver focused telematic options that could be potentially added to a PAYD insurance system. Specifically

the system provides feedback and alerts to parents on their young drivers behaviour. This includes speed limit monitoring, location tracking, the setting up of 'safe driving zones' that will alert parents if deviated from, arrival and departure notifications, and the ability to set and be notified of driving curfews. The 'SafeCo' system also offers location tracking and assistance in the case of an accident or break down.

## 2.4 PAYD insurance variations

As the examples given in section 2.3 show, PAYD insurance comes in many forms and in some cases does not even include the traditionally assessed mileage aspect of PAYD. This may in part be because Progressive insurance in the US has several patents on PAYD technology, which may have discouraged competition and led to a need to differentiate any potential PAYD product in the US market (Bordoff & Noel, 2008; Desyllas & Sako, 2012). However, it also highlights the potential for PAYD insurance to be more than just a mileage charge. In fact, it appears that Pay-As-You-Drive can be interpreted to be Pay-How-When-and-Where-You-Drive or nearly any combination of these factors.

A common measure of driver behaviour in behaviour based PAYD insurance systems is acceleration. For example, the Co-operative Insurance, 'Drive safe and save', 'Drive-wise', 'Ingenie', 'Insure the box', 'Onboard Advisor', and 'Snapshot' products described above all use some measure of acceleration in setting their premiums or changing the discount provided to drivers. Specifically, these insurance products assess rapid accelerations, sharp braking, and cornering behaviour. This is in part due to the ease of collecting this type of data via telematics. However, it is also due to the assumption that rapid changes in acceleration results from less smooth and more reactive driving, which may imply that a driver is driving aggressively and not anticipating or paying enough attention to their surroundings (Af Wåhlberg, 2008). Furthermore, rapid changes in acceleration and heavy braking are associated with heavy fuel consumption and environmental impacts (Barkenbus, 2010). For example rapid accelerations and decelerations (over 1.5 $m/s^2$) can have significant impacts on emissions and fuel consumption (Larsson & Ericsson, 2009). Therefore, feedback on acceleration behaviour, such as the feedback that could be built into a PAYD insurance system, particularly if delivered in car, has been shown to be able to decrease fuel consumption by 10% (Barkenbus, 2010). Ten percent is quite a significant reduction in fuel consumption and if taken across the whole US vehicle fleet it would result in an estimated reduction of $CO_2$ emissions by nearly 100 metric tons.

Pay-As-You-Speed is another variant of PAYD insurance that has been investigated. In this variant a charge for exceeding the speed limit is added in addition to, or instead of a mileage based charge. As mentioned previously, the studies by Greaves & Fifer (2011) and Bolderdijk, et al (2011) both found that detecting and charging drivers for speeding can result in significant reductions in speeding. Similarly, the study by Mazureck & van Hattern (2006) found that speeding could be reduced by as much as 20% based on providing a reward ranging between 0.01 and 0.04 euros per 15 seconds spent not speeding in combination with constant in-car feedback on driver behaviour and the amount of reward earned. PAYD insurance that is based on risky on-road behaviour therefore offers a great opportunity to correct the fact that rewards for good behaviour while driving are rare whereas the rewards for risky behaviour are common and the consequences of running risks are rarely felt (Fuller, 1984; Näätänen & Summala, 1974; Rothengatter, 1988). Since this opportunity to provide feedback and rewards is one of the major features of PAYD insurance it will be discussed in more depth in Section 3 of this report.

### 2.4.1 Intelligent Speed Adaptation

Before moving on it is worth discussing one speed related in-car feedback device that has been well researched and could be easily added to a PAYD insurance package. Perhaps even just as an optional extra. That technology is Intelligent Speed Adaptation, also known as intelligent speed assistance or ISA. ISA can come in several forms, including a device that completely limits the ability to drive over the

speed limit (Carsten & Tate, 2005; Regan, Young, & Haworth, 2003). However, the form that is of most interest in reference to PAYD insurance is an advisory system. An advisory ISA system simply displays the current speed limit on an in-vehicle device, which is usually set via an inbuilt GPS map such as those that may be already associated with a PAYD system (Litman, 2011; Regan et al., 2003). Then, if the speed limit is exceeded by a certain amount, the ISA provides an alert or reminder to the driver. The driving force behind such ISA systems being that a significant proportion of speeding is assumed to be due to habit and may therefore be performed unintentionally due to missed signs or mixed signals from the road environment (e.g. Charlton, 2006; de Waard, Jessurun, Steyvers, Regatt, & Brookhuis, 1995; Lewis-Evans, de Waard, & Brookhuis, 2011). It is therefore assumed that reminding a driver of the speed limit would decrease unintentional speeding and perhaps lead to the formation of newer, safer, driving habits. Such speed reminder systems are built into many commercial GPS products already.

In experimental trials, many of which have been conducted both in large scale and on-road, advisory ISA has been shown to significantly decrease speeding, along with reductions in the variability of speed and in fuel consumption in some instances (e.g. Brookhuis & de Waard, 1999; Lahrmann et al., 2011; Päätalo et al., 2002; Sundberg, 1999). Such advisory ISA systems have been reported to decrease average driving speed by as much as 5 km/h, an amount that could result in a 20% decrease in fatal accidents (OECD-ECMT, 2006a). Furthermore, it has been estimated that if widely adopted, or mandated, even the most basic form of advisory ISA system would decrease injury crashes by 10% and fatal crashes by 18% UK (Carsten & Tate, 2005).

The addition of speed monitoring to a PAYD system, even if just in the form of a simple advisory system, but especially if it was tied to charges or loss of a bonus in a PAYD insurance system, could risk lowering acceptance for such PAYD. This would likely be due to a negative association in consumers between speed monitoring and traditional speed enforcement and a fear that speed data could be passed on to authorities. On the other hand, the introduction to speed monitoring via PAYD insurance, where the penalties for speeding would be less than those levelled by traditional enforcement and where people could be rewarded for sticking to the speed limit could help reduce the stigma that is sometimes associated with speed enforcement. In fact initial acceptance for advisory ISA is often relatively high, with approval rates above 50% (Brookhuis & de Waard, 1999). Also, much like for PAYD insurance (e.g. Buxbaum, 2006) acceptance for advisory ISA also tends to increase once it has been experienced by drivers, with as many as 70-90% of the participants in an Swedish ISA trial saying that advisory ISA was useful to them after they had tried it (Biding & Lind, 2002). ISA also has the potential to save users from receiving fines that they would have got otherwise due to their non-intentional speeding behaviour, a point that could be used in marketing to increase acceptance for the technology.

An advisory ISA was combined with a Pay-As-You-Speed system in a study carried out in Denmark (Lahrmann et al., 2011). The study offered drivers up to a 30% discount off their insurance premium based on their speeding and in addition provided an advisory ISA system to give immediate feedback on both the discount they had earned and their speeding behaviour. The study was unfortunately ended prematurely due to a problem with recruiting participants (who at one point in the study had to pay to participate). However, the data they did manage to collect was promising in terms of showing reductions in the proportion of time spent 5 km/h or higher over the speed limit. The decrease in speeding was strongest for those participants who were in the Pay-As-You-Speed combined with in-car ISA condition. Interestingly, however, if just those in a Pay-As-You-Speed condition (with no ISA) were compared to those who only received ISA then advisory ISA had a stronger effect than Pay-As-You-Speed alone. That just the provision of immediate, in-car, feedback was more effective than adding an incentive not to speed shows the power of immediate feedback.


# 3. Rewards, penalties, and Feedback

Both economics and behavioural psychology rely on the correct use of incentives to motivate human behaviour (e.g. Gneezy et al., 2011; Lattal, 2010; Renner, 1964; Skinner, 1953; Thorndike, 1911; Watson, 1917). That incentives motivate people is in fact so central to economics that Gneezy, Meir, and Rey-Biel (2011) state that the 'economic law of behaviour' is simply that giving higher, positive, incentives will lead to more effort and higher performance. Radical behaviourism also concludes that all behaviour is driven by its consequences (Skinner, 1953; Skinner, 1974).

Consequences, or incentives, can either be negative or positive and can be referred to as rewards (positive) or penalties (negative). Furthermore, within behavioural psychology a distinction is made between a positive consequence for a behaviour (a reward) and such a reward that increases the probability of the behaviour occurring again in the future, which is called a reinforcement (Cameron & Pierce, 1994; Cameron et al., 2001; Skinner, 1974). This means that a behaviour can result in a reward (a positive consequence) but only if this reward leads to an increase in the probability of this behaviour occurring again can the reward be considered a reinforcement. Similarly there is a distinction between a negative consequence for a behaviour (a penalty or loss) and a negative consequence that decreases the probability of the behaviour occurring again in the future, which is called a punishment (Skinner, 1974). The distinction between a reward and a reinforcer, or a penalty and a punishment, is ultimately a circular one. In that a reward can only be called a reinforcer if it is shown at a later date to increase the probability of a behaviour occurring again in the future. Similarly a penalty can only be called a punishment, in behavioural terms, if the penalty decreases the probability of a behaviour occurring again in the future (Cameron & Pierce, 1994; Cameron et al., 2001). It is still worth pointing out that just because a positive or negative consequence occurs in the form of a reward or penalty it does not mean that behaviour will change. The rest of this section therefore looks at how to best provide rewards, penalties, and feedback on these consequences to individuals in order to produce behaviour change.

## 3.1 How to effectively deliver rewards and penalties

In order to increase the chance that a reward does become a reinforcer, or a penalty becomes a punishment, there are a few points that need to be considered. First of all the two most important factors are that the reward or penalty is as closely and clearly associated with the behaviour that is to be targeted as possible (Skinner, 1974). This means that the reward or penalty should, in terms of time, follow as closely as possible to the time at which the behaviour occurs. It should also be clear exactly what behaviour caused the reward or penalty to be received. In other words, performing the behaviour must reliably predict the receiving of a reward or penalty within a short time frame. The idea is that this then gives important feedback to the person receiving the consequence and lets them clearly link it to the behaviour that they were performing. Therefore, the longer the time between the behaviour and receiving a reward the less likely that the reward will become a reinforcer and therefore increase the chance that the behaviour will occur again in the future.

In the case of a penalty it is extremely important that this link between the behaviour and negative consequence is clear, strong, and as immediate as possible (Skinner, 1974). To do otherwise can breed additional resentment, feelings of fear, or a feeling of injustice as it becomes unclear when and if a particular behaviour will be punished. In this fashion the certainty of detection of a negative behaviour is considered to be of vital importance. This increase of the (perception of) the certainty of detection is one of the main driving forces behind the idea of automated speed enforcement via camera systems (Cameron, Delaney, Diamantopoulou, & Lough, 2003).

Conversely, while it is important that a reward quickly follow the behaviour it is intended to encourage it is not necessarily the case that it must follow the behaviour every single time. When a behaviour is rewarded every single time it occurs or after a fixed number of occurrences it is known as a fixed schedule of reinforcement (Skinner, 1974). Fixed ratio schedules of reinforcement are good at maintaining a relatively high and steady level of response and for establishing an initial link between

a behaviour and a positive consequence. This is because they very predictably link a behaviour, e.g. pressing down on the accelerator quickly, with a positive consequence, e.g. a pleasurable feeling of acceleration. However, fixed ratio schedules of reinforcement have two downsides. One is that after the reward is delivered there tends to be a pause, or stop, in the behaviour that has been rewarded. This can be viewed as occurring because the person has just got the reward and knows that they can easily get another by responding again the required amount of times. The other disadvantage is that once the fixed ratio reward is removed the behaviour it is associated with also usually quickly stops. That the behaviour stops quickly when the reward is removed is due to the predictable link between the reward and the behaviour, so when the reward stops coming a clear signal is sent that the behaviour is also not as important or needed. Fixed ratios are therefore somewhat poor at forming habits that will continue once the reward has been removed.

On the other hand, if a reward is received after a variable number of times, e.g. only the 10$^{th}$ time on average that you perform the behaviour, this is called a variable ratio schedule of reinforcement (Skinner, 1974). Variable ratios, due to their somewhat more unpredictable rate of reward result in even higher rates of responding than fixed ratio schedules because while the person knows a reward is coming, they do not know when. Also because past experience has taught the individual that reward will come eventually if they just keep trying a variable reinforcement schedule also tends to lead to behaviour that is more likely to form a long lasting habit. A classic example of a variable ratio reinforcement schedule is that used by a jackpot gambling machine in a casino.

The fact that the certainty and swiftness of a reward or penalty are so important highlights the need for feedback. Specifically it highlights the importance of immediate feedback on behaviour. Feedback also offers the opportunity to communicate information immediately about a reward that may actually be delivered later, e.g. progress towards a reduction in insurance premiums. In this case the feedback is a medium that replaces the actual reward and it has been shown that much like how money is traded for goods, the medium can be as motivating or more so, than the actual reward (Bagchi & Li, 2011; Hsee et al., 2003). That immediate, continuous, feedback is more effective than delayed feedback is highlighted in a study by Van Houwelingen & Van Raaij (1989) that looked at providing feedback to households on their energy use. It was found that those who received continuous, immediate, feedback on their use of gas saved significantly more (a 12.3% reduction in gas use) than those who were given monthly (a 7.7% reduction in gas use) feedback. Furthermore, as mentioned in Section 2.4.1, a Demark based Pay-As-You-Speed and advisory ISA study found that immediate feedback by itself (i.e. just the ISA system) produced more of a reduction in the proportion of time spent speeding than simply the addition of a delayed reward (Lahrmann et al., 2011). However, the combination of immediate feedback on the reward and the advisory ISA had the largest effect.

The preference that people have for immediate rewards, even if they are smaller than more delayed rewards, is referred to as reward discounting and is in some senses biological (Hariri et al., 2006). Specifically, ventral striatal brain activity is considered to be related to the anticipation and processing of rewards. Neurological studies have found that small, yet immediate rewards lead to increases in ventral striatal activity in the brain when compared to larger delayed rewards (Hariri et al., 2006; McClure, Laibson, Loewenstein, & Cohen, 2004). Immediate rewards also seem to increase the activity in the medial prefrontal cortex and orbitofrontal cortex, both of which are associated with decision making and particularly with risky decision making (McClure et al., 2004). Therefore, it appears that humans are biologically predisposed to prefer immediate rewards, a predisposition that a good in-car feedback system associated with PAYD insurance could take advantage of.

The final aspect related to whether a reward or penalty becomes a reinforcer or punishment is the size (or severity) of the reward/penalty. Simply speaking, the reward or penalty must be large enough that it motivates the person receiving it (Gneezy & Rustichini, 2000; Skinner, 1974). The size or severity of reward or penalty is, however, the least important factor in determining its effectiveness (Bjørnskau & Elvik, 1992; Skinner, 1974; Zaal, 1994). That the severity of a punishment is the least effective element is sometimes surprising to people. However, think of this example; which is likely to be more effective? A

device that detects the blood alcohol level of a driver every single time they enter the car and penalises them with the relatively low penalty of being unable to drive until they are sober or police enforcement that only detects, on average, a drunk driver once per 27,000 miles driven drunk (the chance of being detected for drunk driving in the US (Levitt & Porter, 2001), with a large and quite delayed consequence of jail time or a fine? In the first case, the use of an alcohol interlock, detection is nearly guaranteed and therefore the driver cannot risk themselves or others, meanwhile all that the driver has lost is an opportunity to drive. In the last case the penalty for drunk driving is high yet the chance of detection is low, so is it any surprise that despite a tendency for increases in enforcement and the penalties for drink driving that alcohol related road accidents are still one of the most common causes of road deaths worldwide (World Health Organization, 2009). In fact, studies in Australia (Briscoe, 2004) and the USA (Wagenaar et al., 2007) have reported that increasing the severity of a penalty associated with drunk driving, including doubling the normal jail time and penalties in the Australian example, has very little effect on drunk driving re-offending.

An example that reward size is not the most crucial factor can be taken from the Belonitor trial in the Netherlands. This trial started off with a relatively low reward rate of 0.04 euros per 15 seconds performing the required behaviours. However, during the trial they reduced the reward to 0.01 euros per 15 seconds and found that this lower reward appeared to be just as effective (Mazureck & van Hattem, 2006). That there was no change in the Belonitor trial as the reward rate decreased is likely also linked to the fact that participants in the trial also had immediate in-car feedback on their driving behaviour and therefore had clear feedback on when they were and were not receiving the reward.

Even if the size of a reward or penalty is generally considered to be the least important factor it is still something that must be considered. The economists Gneezy and Rustichini (2000) have particularly emphasised the effect of reward size. In a paper entitled "Pay enough or don't pay at all" Gneezy and Rustichini (2000) even claim to show that rewards that are low may in fact produce behaviour at lower rates than if people were not paid at all. However, many of their results were not statistically significant at the $p < 0.05$ level. Care should also be taken with large rewards, as Ariely, Gneezy, Lowenstein, and Mazar (2009) have suggested that rewards can be too high, which induces high mental workload and anxiety that can cause people to 'choke' or under perform.

One way to get around the potential problem of small rewards is to use a medium such as points that are earned and then traded off for a tangible reward. Such point based systems are used extensively in so called 'loyalty' programmes, such as air miles or in-store cards that offer points for purchases (Henderson, Beck, & Palmatier, 2011). Points can be varied in larger amounts than the underlying reward, i.e. it is easy to give 1,000 points for a behaviour but not so easy to give 1,000 euros, and people are sensitive and reactive to large numbers as they associate them with large sizes (Pelham, Sumarta, & Myaskovsky, 1994). This bias towards large numbers can also impact on individuals feelings of progress towards a reward. In that they will prefer a system where they gain 10 points per time unit in a system where they need 1,000 points to get a reward over a system where they get 1 point per time unit but only need 100 points to get a reward (Bagchi & Li, 2011). Furthermore there is evidence that people are relatively insensitive to the rate that points trade off to actual rewards. Meaning that people react to the amount and rate that they earn points and not to the underlying rate at which those points can be translated into rewards (Hsee et al., 2003; Van Osselaer, Alba, & Manchanda, 2004). For instance in their 2003 study Hsee, Yu, Zhang and Zhang found that people were willing to listen to an aversive sound for longer if they received points in a linear fashion even if the trade off to the later reward of candies was non-linear (so points were actually worth less candies per point). Whereas if the medium of points were earned in a non-linear fashion but traded off linearly (so points were actually worth more candies per point) the participants did not listen to the aversive sound as long. In a similar fashion van Osselaer et al. (2004) found that people tend to pick air-points schemes that appeared to give the most points immediately, even if the way those points traded off into actual rewards was worse in the long run.

## 3.2 Rewards or penalties?

Both rewards and penalties are aimed at the same goal, producing a desired behaviour or behaviours. But which is the most effective at achieving this goal? The answer from behavioural psychology is clear: rewards should be used and penalties should be avoided[2] (Cameron & Pierce, 1994; Gneezy et al., 2011; Lattal, 2010; Renner, 1964; Skinner, 1953; Skinner, 1974; Thorndike, 1911; Watson, 1917). The avoidance of penalties and punishments is advocated for several reasons. Firstly, as mentioned above penalties, more so than rewards, need to be delivered rapidly and certainly in order to be effective. In many practical situations this is difficult to achieve due to the cost of monitoring, both in terms of money and time, and the fact that people will work to avoid being detected and punished. A consequence of people trying to avoid being detected is an increase in deception and a decrease in trust between those being penalised and those delivering the penalty. Related to this decrease in trust, penalties also tend to increase negative feelings in general towards the person or entity that is delivering a penalty. This can especially be the case if the application of penalties is viewed as being unfair due to low detection rates and a slow delivery of the eventual penalty. Finally, penalties only clearly communicate what should not be done. They do not, generally, inform the person that is being penalised as to what they should be doing instead.

Rewards on the other hand communicate to the receiver that the behaviour they are doing is correct, or at least on the right track, and should be continued in the future. This informative element of rewards is a major advantage over the use of penalties as it communicates what should be done, and also in the case of performance dependent rewards, how well it should be done. Also, depending on how the reward is delivered, a reward could lead rewarded individuals to develop positive associations with the person or entity doing the rewarding. These positive associations do, however, depend on how the reward is distributed. If rewards are not handled or distributed well it is possible that the reception of rewards can be perceived as an attempt to manipulate or control and this may reflect negatively upon the person or entity providing the reward (Deci et al., 1999; Deci et al., 2001).

This raises the issue of rewards, penalties, and control. Ultimately, it is true that rewards and penalties are an attempt at control, and generally speaking people resist and resent being controlled (Deci et al., 1999; Deci et al., 2001). In fact, if people have an impression that they are being controlled, either by penalties or rewards, they may react by performing the opposite behaviour to that which is desired, this is called countercontrol (Skinner, 1972) or psychological reactance (Brehm, 1966). Similarly, feedback on performance can also be seen as controlling depending on how it is given and so may also lead to resentment or dissatisfaction in those who receive the feedback (Deci et al., 1999; Deci et al., 2001). Therefore, in order to minimise the negative impacts of giving rewards or feedback it is important that feedback or rewards are given in a way that is neutral or non-judgemental and could not be taken as attempting to control an individual. It is also helpful if the reward or feedback can be tied directly to positive performance and provide information on what was done correctly (Ryan, 1982). So, for instance, feedback should read "You consistently drove under the speed limit in the last week and earned 300 points" rather than "It is expected that you should drive under the speed limit, you did so in the last week and earned 300 points." In the second example, by making the driving under the speed limit an 'expectation' it increases the implication that rewards are being used to control rather than creating the impression that a reward is being given in recognition of behaviour that was voluntarily performed. In general in order to avoid rewards being seen as controlling steps should be taken to minimise using an authoritarian style or creating an impression of pressure. Furthermore, it helps if there is choice in how the rewarded task is carried out and if the interesting or challenging aspects of the task are emphasized (Ryan, 1982).

Perhaps in reaction to the negative effect that a perception of being controlled can cause, some have even started referring to incentive and behavioural techniques as 'nudges'. The term 'nudge' is used to give the impression that these techniques 'nudge' (i.e. gently move) people towards the right choice rather than controlling or forcing them (Thaler & Sunstein, 2008). The term 'nudge' is therefore, given that people generally dislike feeling controlled, a clever bit of marketing. Care should be taken, however,

2 In the language of behavioural psychology: reinforcements are preferred and punishments should be avoided.

that decision makers do not buy their own spin and start to think that 'nudges' are a new or special type of intervention rather than just a new name for old methods of control and influence. Rather, the idea of a 'nudge' should be taken as what it is; a way to sell regulations, new technology, and environmental interventions in a fashion that is more palatable to other decision makers, consumers, and the general population.

The idea that feeling controlled reduces the effectiveness of a reward can be linked to self-efficacy theory (Bandura, 1982) as well as to Cognitive Evaluation Theory (CET) (Deci, 1975). Self-efficacy is, simply put, the idea that people tend to do, and try harder to do, things they believe that they are capable of doing. Since self-efficacy is based, partly, in feeling in control (Bandura, 1982), the feeling of being controlled or having control taken away from you by an external reward could reduce an individual's self-efficacy and therefore cause them to stop trying. Similarly, CET states that people have an innate need to be competent and to self-determine their behaviour (Deci, 1975). CET states that rewards or positive feedback could potentially increase feelings of competence, however, if the reward or feedback is given in a controlling fashion this could impact on the need of an individual to self-determine their behaviour and therefore may have negative consequences on their motivation (e.g. Deci et al., 1999; Deci et al., 2001). The controlling effect of rewards has even led some to argue against the use of rewards completely, as controlling people in any fashion is seen by some as immoral (e.g. Kohn, 1999).

### 3.2.1 External and internal motivation and rewards

A less extreme argument put forward against the use of external rewards is that they may decrease intrinsic motivation to perform the behaviour being rewarded, meaning that once the external reward is gone people may no longer be motivated to perform the behaviour (Cameron & Pierce, 1994; Cameron et al., 2001; Deci et al., 1999; Deci et al., 2001). Also the reduction in intrinsic motivation may reduce the pleasure or sense of moral correctness that an individual feels for performing a specific behaviour, replacing it with the motivation to simply gain external reward (Deci, 1975; Deci et al., 1999; Gneezy et al., 2011). If these negative impacts on intrinsic motivation do occur, it is obviously something to be concerned about, although it could be argued that since the reward is never removed from PAYD insurance, unless the customer quits, then these concerns will not apply as strongly.

To be clear, intrinsic motivation is defined as when a behaviour or activity is performed with no apparent external reward, except for those that come with doing the behaviour itself (Deci, 1975). In contrast, someone is said to be extrinsically motivated if there is an external control acting to encourage the behaviour or activity that is being performed (Cameron & Pierce, 1994). While there is some argument if there is even such a thing as a behaviour that can be performed for no external reward (e.g. Bandura, 1986; Cameron et al., 2001; Dickinson, 1989; Skinner, 1972), a simplification of the intrinsic versus extrinsic distinction would be that intrinsically motivated behaviours are done only for your own personal gratification or because you feel personally that they should be done no matter the external reward. Whereas extrinsically motivated behaviours are done in order to gain something from the environment or world around you.

The argument that external rewards reduce intrinsic motivation is a long, complex, and controversial one. Perhaps the best example of this controversy is a conflicting series of meta-analytic studies that have examined the literature on this subject but came to quite different conclusions (Cameron & Pierce, 1994; Cameron et al., 2001; Deci et al., 1999; Deci et al., 2001). The first meta-analytic study in this series was published by Cameron & Pierce in 1994 and came to the conclusion that there was no good evidence for external rewards decreasing intrinsic motivation. In more detail they reported that verbal rewards (positive feedback) tend to increase intrinsic motivation and that only if external rewards are given for just doing a task do they result in any decrease in intrinsic motivation. Meaning, that only if a reward was given for simply trying to do the task, and not based on certain level of performance, is providing a reward a problem. Furthermore, only if the reward is expected by the person receiving

it is there any negative impact. Cameron and Pierce (1994) also join some earlier authors (e.g. Bates, 1979) in criticising the research methods used to assess the impact of rewards on intrinsic motivation, noting that most studies include no baseline measurements of intrinsic motivation, only present the reward once, and do not check to see if the reward is motivating, i.e. that the reward is a reinforcer. Cameron and Pierce (1994) follow these criticisms up by pointing out that if the few, within-subjects designed, studies in this area that have taking baseline measures and provided multiple reinforcements are examined then there is no clear evidence of any reduction in intrinsic motivation once the rewards were stopped (e.g. Davidson & Bucher, 1978; Feingold & Mahoney, 1975; Mawhinney, Dickinson, & Taylor, 1989; Vasta, Andrews, McLaughlin, Stirpe, & Comfort, 1978). Furthermore, based on the findings of their meta-analysis Cameron and Pierce (1994) claim that CET (Deci, 1975), one of the most popular theories that predicts a reduction in intrinsic motivation to follow the removal of extrinsic rewards, should be abandoned.

The next meta-analysis in this area, was published initially by Deci, Ryan, and Koestner (1999), and summarised by Deci, Koestner, and Ryan in 2001. In the publications Deci, Ryan, and Koestner pointed out some methodological problems with the Cameron and Pierce (1994) study, added some additional studies, and also made a crucial point about the impact of rewards on intrinsic motivation. That crucial point being that the reductions in intrinsic motivation after the addition of external rewards only applies to interesting tasks. That is to say that tasks that are dull or uninteresting do not suffer from reductions in intrinsic motivation after the addition of external rewards as they are not particularly intrinsically motivating anyway. That there is no demotivating impact of external rewards on dull tasks fits well with research that has also found that as a task becomes more cognitively demanding or creative then rewards become less effective in producing increases in performance (Bonner, Hastie, Sprinkle, & Young, 2000). That external rewards only have a negative impact on interesting or creative tasks is quite good news for those who would want to externally reward, through PAYD insurance for instance, safe driving behaviour, as safe driving behaviour can often be relatively simple, habitual, and subjectively dull.

Deci, Ryan, and Koestner (1999) then report that, in contrast to Cameron and Pierce (1994), their meta-analysis shows that there are significant decreases in intrinsic motivation associated with nearly all types of external rewards. With one exception, that being rewards given for just being present, i.e. not contingent on even trying a task, did not show any effects. Similarly to the previous meta-analysis they also found that positive feedback could increase intrinsic motivation and that unexpected rewards did not impact on intrinsic motivation (Cameron & Pierce, 1994; Deci et al., 1999; Deci et al., 2001). Although Deci, Ryan and Koestner (1999) do also point out that, in line with CET (Deci, 1975), positive feedback is only effective in increasing intrinsic motivation if not given in a controlling fashion (Deci et al., 2001).

In response to Deci, Ryan, and Koestner (1999) another meta-analysis was carried out by Cameron, Banko, and Pierce in (2001). In this later analysis Cameron, Banko, and Pierce (2001) acknowledge the methodological problems pointed out by Deci, Ryan, and Koestner (1999) and attempt to correct them. Furthermore, they point out some methodological issues with the Deci, Ryan, and Koestner (1999) study and add a few additional papers into the meta-analysis. With one of the biggest changes in this later meta-analysis from the earlier Cameron and Pierce (1994) study being an examination of the impact of external rewards on low and high interest tasks separately. The results showed that not only is intrinsic motivation not negatively impacted by external rewards in the case of low-interest tasks but that intrinsic motivation for these dull, uninteresting tasks can be increased by adding external rewards. This is in line with the idea that rewards can be good at increasing interest in an activity that is not it itself particularly intrinsically motivating (Bandura, 1986). Such as, for example, staying below the speed limit or accelerating slowly and smoothly.

In terms of the impacts of external reward on interesting tasks, as in the earlier meta-analyses there was an enhancing effect of positive feedback on intrinsic motivation (Cameron & Pierce, 1994; Cameron et al., 2001; Deci et al., 1999). Cameron, Banko, and Pierce (2001) also found negative effects of external rewards if they were expected and based on doing the task or simply showing up. Although, these

negative effects were only if a test of intrinsic motivation, known as the free choice test (Deci, 1971) was examined. In the free choice test the reward is removed and then participants in a study are observed for a certain period to see if they continue to do the rewarded activity or not. However, if subjective ratings of motivation were examined instead of the free choice test no negative impacts were found.

That the meta-analyses described above all examined pretty much the same literature and came to quite separate results is not particularly helpful for anyone looking to implement rewards in an applied setting. However, there are some points that all the above authors seem to agree on; Firstly, that external rewards have no (or a positive) impact on the intrinsic motivation to perform dull or uninteresting tasks. As mentioned above, this is a promising finding for the use of rewards to motivate people to do behaviours that they would usually have no or low interest in performing, such as certain dull, but safe, driving behaviours. Secondly, positive feedback seems to have an enhancing effect on intrinsic motivation. Although care should, according to Deci, Ryan, and Koestner (1999), be taken that the positive feedback is not given in a controlling manner. Finally, unexpected rewards also have no impact on intrinsic motivation. This last point, where rewards that are given with no prior knowledge of their ability to be received, is less useful for applied settings however, as once a unexpected reward has been given for a task once it is likely that further rewards for the task become expected.

It is also worth restating that the studies used in the meta-analyses mentioned above usually only looked at a single period of reward delivery, followed by removal of the reward, and then an assessment of intrinsic motivation. However, in applied settings, such as with PAYD insurance, rewards are likely to be given multiple times and for extended periods before being removed, if they are removed at all.

Two additional points about the use of rewards should also be made before moving on. The first is that as long as there is any chance that a reward or the maximum reward cannot be received then in addition to the reward a penalty has also been introduced. Therefore all the negative consequences associated with penalties may also come into play (Deci et al., 1999; Kohn, 1999). So for example in the case of a PAYD insurance plan where customers work towards a maximum 30% discount off their insurance premium, not managing to achieve the full 30% discount in a certain reward period may be perceived as a penalty. The second point is that there is some evidence that external rewards that are 'task-inherent' may not have a negative impact on intrinsic motivation. That is to say that rewards that are associated with the task, so for example discounts on car insurance with driving, are not demotivating. Whereas, rewards that are not normally associated with a task, say for example movie tickets as a reward for safe driving, may have more of a negative effect, at least for interesting tasks (Bates, 1979).



### 3.3 Rewards, penalties, and feedback in the driving environment

One of the largest problems in driver safety is that driving, at an individual level, is relatively forgiving and rewarding of risky behaviour (Fuller, 1984; Näätänen & Summala, 1974; OECD-ECMT, 2006b; Rothengatter, 1988). However, as mentioned above the consequences, good or bad, that are experienced most often are those that will have the largest impact on behaviour (Skinner, 1974; Thorndike, 1911; Watson, 1917). In the case of the road environment positive feedback in terms of positive feelings and perceived time savings, on risky behaviour, such as speeding or rapid accelerations, is often very swift and certain (e.g. Rothengatter, 1988). Conversely, the potentially large and serious consequences of unsafe behaviour are seldom experienced by any one individual and in the case of death or serious injury a driver may never have the chance to learn from such consequences (Fuller, 1984; Näätänen & Summala, 1974). For example an average driver in the US has only a 0.09 probability of being involved in an accident per year of driving, with the chance of being injured or killed in such an accident being even lower (Evans, 2004).

Safe behaviour on the other hand is not usually obviously and directly rewarded. The only reward that

a safe driver generally gets is reaching their destination without incident. However, given the generally forgiving and low risk nature of the road environment the risky driver also usually arrives at their destination without incident and gains more immediate pleasure and other rewards for doing so, e.g. time savings, the approval of peers, gaining an advantage over other traffic, and so on (Fuller, 1984; Fuller, 1992). Furthermore, the safe driver may be punished for their behaviour by feeling increased time pressure or the aggression and/or disapproval of other motorists.

In terms of the official, legislative, use of reward and penalties in road safety the use of reward is relatively rare. However, some studies have looked at the provision of information about driving and the consequences of behaviour. Advisory ISA systems, discussed above, are one such informational channel that has been investigated and shown to be effective in reducing speeding (e.g. Brookhuis & de Waard, 1999; Lahrmann et al., 2011; Päätalo et al., 2002; Regan et al., 2003; Sundberg, 1999). The use of road side speed warnings, particularly around work areas, has also been investigated and shown to have significant impacts on driver speed (Roberts & Smaglik, 2012; Sorrell, Sarasua, Davis, Ogle, & Dunning, 2007). Incentive schemes to increase seatbelt use, particularly in US States where seatbelt use was not mandated, have also been found to have significant effects in both the short and long term (Hagenzieker, Bijleveld, & Davidse, 1997). With some studies reporting a doubling of, initially low, safety belt wearing rates immediately after rewards were introduced (e.g. Geller, 1984; Geller, Rudd, Kalsher, Streff, & Lehman, 1987).

In contrast to the relative lack of reward systems in official attempts to improve road safety, penalties are extensively used via laws and associated enforcement efforts. Furthermore, it is quite usual for policy makers to focus on the less effective element of the severity of penalties (e.g. higher fines, stricter sentencing) rather than the more effective aspect of the certainty that punishment occurs due to the relative ease of adjusting penalty severity (Armour, 1984; Bjørnskau & Elvik, 1992). Although, as mentioned previously, speed cameras and other automated speed enforcement devices are attempts to increase the certainty of detection. However, even in the case of automated speed enforcement the swiftness with which a penalty is actually received can be relatively slow.

In terms of environmental behaviour, fuel use is a bit more of a feedback, reward, and penalty system that can be coupled with driver behaviour. However, while some modern cars may show the current fuel use, most old vehicles only show the amount of fuel left and this information is not as immediate in terms of linking current moment-to-moment behaviour with fuel use and environmental impacts. Furthermore, the real cost of fuel use, or benefit of eco-driving, is not truly apparent until drivers are at the pump, which is somewhat removed from the actual task of driving. Larger environmental impacts, such as climate change, are also largely invisible. It is because of this lack of clear and immediate feedback that some have suggested that feedback on moment to moment eco-driving be added to vehicles (e.g. Barkenbus, 2010; Meschtscherjakov, Wilfinger, Scherndl, & Tscheligi, 2009).

Ultimately, the naturally low feedback environment of driving in terms of rewards for both environmental and safety effects and a strong focus on punishment in road safety leaves an obvious gap for an immediate and continuous reward system. PAYD insurance could be a good candidate to fill that gap and provide immediate and clear information on safe and eco-friendly behaviour to drivers.

# 4. Additional persuasive behaviour change techniques

Feedback, especially if it is provided in a timely and non-controlling fashion, has been shown to have positive impacts on behaviour and intrinsic motivation (Cameron & Pierce, 1994; Cameron et al., 2001; Deci et al., 1999; Deci et al., 2001). What rewards, penalties, and feedback do is essentially provide information to an individual on the consequences of their behaviour (Skinner, 1953). However, rewards and feedback can be framed and presented in different ways and can also be associated with various additional persuasive approaches such as comparisons, conformity, framing, goal setting, modelling, framing, and reciprocity (Bolderdijk, Steg, Geller et al., 2012; Cialdini & Trost, 1998; Cialdini, 2001; Cialdini & Goldstein, 2004; Lehman & Geller, 2004; Lehman et al., In Press). These persuasive approaches can, much like rewards and feedback, help highlight the consequences of behaviour after it has occurred. However, some other approaches can be used before behaviour occurs, such as getting a commitment or goal setting, again in the hope that they persuade individuals to perform or not perform a targeted behaviour. Both types of approach for persuasive behaviour change are discussed in this section.

## 4.1 Conforming to authority

In general people respond to others that have high status or authority (Cialdini, 2001). This is because it is impossible and quite effortful for everyone to have all the information and expertise needed to make every decision. Therefore the opinions of experts and other authority figures can be used as short cuts or easy heuristics for decision making (Lehman et al., In Press).

The responsiveness to authority does, however, depend on how authority is exerted. Cialdini and Goldstien (2004) identify two types of tactics that can be used to imply and exert authority, soft and hard. Soft tactics refer to factors of authority that come from the individual or organisation themselves. These include if the individual is liked or if they appear credible based on their own abilities and past behaviour. As such, this kind of soft authority can also sometimes be referred to as expert authority. Hard tactics on the other hand come from authority that is solely related to the position of the individual or organisation in social structures, which is sometimes referred to as legitimate authority. Legitimate authority applies, for example, if someone is higher up than you in an organisation but you have no idea if they are capable or not. These tactics are not mutually exclusive in that someone can have both soft and hard authority. However, given that soft authority is based on actually demonstrating ability and credibility, people or organisations that primarily exert soft authority are generally preferred by individuals. For example in work conditions where an employer is perceived as credible and competent, employees usually rate their job satisfaction as higher than if the employer primarily relies on hard tactics for exerting their authority (Cialdini & Goldstein, 2004). That the application of hard tactics, or legitimate authority, is more likely to breed dissatisfaction or resistance is also likely tied to the fact that it is more likely to be perceived as controlling and people generally do not like perceiving that they are being controlled (Brehm, 1966; Deci et al., 1999; Deci et al., 2001; Skinner, 1972). So, the message that an authority sends is altered by an individual's perceptions of to what extent that authority is an expert and how legitimate it is in terms of the social structure (Cialdini & Goldstein, 2004).

Messages may also be coloured by what an authority is perceived to gain by exerting their authority and the broadness of the issue in terms of societal impact. For example, in a study examining power use, households were sent letters about reducing electricity use. Both letters were identical, except one gave the impression it came from the government and the other from the impression that it was from a power supply company. The letter that was supposedly from the government was more effective in reducing electricity use (Craig & McCann, 1978). It is possible, in this case, that the government was viewed as more credible as they have less to directly gain or lose from power savings and may be seen as a more credible source for the impact of power savings on society as a whole. Therefore, in the case of PAYD insurance it could be useful if insurance companies work with government and outside experts in order to assert soft, expert, authority on the effectiveness and desirability of PAYD systems. This is because businesses, like insurance companies, are generally assumed to have a selfish profit motive. Therefore, customers may perceive PAYD insurance as an attempt to increase profits. Even though

research suggests that PAYD could decrease insurance revenues (Adkins, 2004; Bordoff & Noel, 2008). Whereas, it may be that governments or outside experts are perceived more as having society at large in mind when advocating PAYD insurance and may even be able to communicate that customers and society, not insurance companies, are likely to be the largest benefactors of PAYD insurance (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2011). This will of course depend on how legitimate or, more importantly, how expert and credible, a government or external expert is perceived to be (Cialdini & Goldstein, 2004) and on if they are perceived as being controlling or not (Brehm, 1966; Deci et al., 1999; Deci et al., 2001; Skinner, 1972).

## 4.2 Conforming to others

People do not just follow those who have authority. There is also a general tendency for individuals to change their behaviour to match the way those around them are acting (Cialdini & Goldstein, 2004; Lehman et al., In Press). This tendency to conform could be because individuals perceive that others have information about a situation that they do not. This is called informative influence (Cialdini, 2001) and is, like conforming to authority, a type of cognitive shortcut or heuristic along the lines of 'other people tend to do things for good reasons, therefore, it is usually safe to do what others are also doing'. Another reason to conform, called normative influence, is when people conform just to fit in with people around them. In this case, again effort is saved by not struggling against what others are doing but by just going along with the crowd (Deutsch & Gerard, 1955). Both informative influence and normative influence are strongest in situations new or unfamiliar situations (Cialdini, 2001).

Whether people are influenced informatively or normatively is in part related to how much consensus they believe exists around a topic and their own personal belief about that topic (Cialdini, 2001; Cialdini & Goldstein, 2004; Lehman et al., In Press). If people hold strong personal beliefs about an activity or behaviour, yet they perceive a strong consensus that is different to their own beliefs then it is more likely that if they conform it is due to normative influenced and wanting to fit in. However, if people only have moderate or low beliefs about an activity, then it is more likely that informative influence will play a role. In other words, if people do not hold strong opinions on a matter then they will be more likely to perceive that others have information that they themselves lack and vice versa (Erb, Bohner, Rank, & Einwiller, 2002). This may be a problem, as in the case of driving, it is common for the majority of drivers to strongly believe that they are skilled, capable, and safe (McKenna et al., 1991; McKenna, 1993). Therefore, any information that is presented to drivers about the behaviour of others could be filtered through their belief that they are safe drivers themselves. This filtering may cause them to reject social pressures that suggest otherwise.

The power of normative influence on conformity is in turn influenced by social norms. Social norms can be viewed as the rules or codes of conduct that we perceive the society around us to have. These social norms can take two forms (Cialdini & Trost, 1998; Schultz et al., 2007). The first is an injunctive social norm, which are our perceptions of what others approve of or disapprove of. The other is the descriptive norm, which is simply what we perceive as what is normally done by others. Both injunctive and descriptive norms can influence conformity, and it is therefore advisable that normative messages attempt to use both types of norm. For example roadside signs showing that a majority of people were not speeding in an area have been found to reduce speeding behaviour (Van Houten & Nau, 1983). However, care should also be taken when designing messages as to not inadvertently result in normative information that could result in behaviour opposite to that which was intended (Lehman et al., In Press). For instance, a PAYD insurance website could provide information that 80% of customers are routinely speeding. This information could be provided as part of a statement outlining the problem of speeding and trying to convince customers to reduce this behaviour. However, what is also being communicated is that a lot of people speed, and therefore it may create the perception that society at large does not disapprove of speeding (an injunctive social norm), and/or that speeding is what is normally done by other people (a descriptive social norm). Furthermore, this effect is individually relative and does not just apply in extreme cases. So, for example if the message was given that only

30% of customers routinely speed but a person, before this information was provided, thought that only 10% of people routinely speed, they are again receiving information that society views speeding as more acceptable than they thought.

Whether we conform to the wishes of another, or simply follow their behaviour as a guide to our own, also depends on how much we like that person or organisation. Indeed generally speaking the more we like someone or some organisation the more likely will we do as they do or comply with their requests and do what they want us to do (Cialdini, 2001; Cialdini & Goldstein, 2004). One explanation for liking producing conformity and compliance is the halo effect (Thorndike, 1920). The halo effect refers to another cognitive shortcut which says that people we find attractive in one way, either in appearance or behaviour, we tend to assume are also attractive in other ways. A common way of presenting this would be to say that if you find a movie star attractive then it is also likely that you think they are a good, intelligent, and caring person. Another example of the halo effect this could be to apply it to the user interface of a PAYD insurance website or in-car device. If this interface is attractive, easy to use, and likable then it may be that people trust and comply with the information that is provided there more than they would if it was not presented in an aesthetically pleasing fashion. Another way to take advantage of the halo effect is to have prominent members of a society or community promote, and preferably adopt and use PAYD insurance (Erdogan, 1999; Lehman et al., In Press). This type of endorsement is relatively commonly used by companies to promote their products (Erdogan, 1999) but is not without its risks especially if the prominent individual falls from grace or is not perceived to be credible. Credibility is one good reason to try and get any prominent person that is promoting PAYD insurance to also use it themselves. This shows consistency between what they are saying and what they are doing and increases their credibility, and therefore their authority (Cialdini, 2001), as well as increasing the potential halo effect.

Another way to increase likability is to stress the similarities between the individual and the person or organisation that is trying to convince them to comply or conform (Lehman et al., In Press). The connection between liking and similarity is so strong that even faked information about similarities in names, birth dates, or fingerprints can increase compliance with requests (Burger, Messian, Patel, del Prado, & Anderson, 2004). Organisations, such as insurance companies, cannot be similar to individuals in such a direct fashion. However, it is possible for an organisation to find out the values that are important to its customers and then stress that these values are also held by the company. In the case of PAYD insurance this could take the form of framing the insurance in terms of cost savings, safety benefits, or environmental impacts depending on what type of customer is being addressed or the majority concerns of the customer base.

The way that information is communicated can also impact on individuals perceptions of liking. In particular if information is given in a way that more resembles a two-way dialogue then liking will increase (Dolinski, Nawrat, & Rudak, 2001). Dialogues are associated with closer relationships, thus the increase in liking when they are used, instead of monologues, which are more often associated with being given information or talking with strangers. Organisations can take advantage of this by taking care to provide plenty of opportunities for their customers to provide feedback. However, since dialogue must be perceived as two-way, care should also be taken that customers feel that the organisations responding quickly and fairly to their feedback. This may be cost prohibitive.

## 4.3 Comparison and competition

As part of the processes of perceiving social norms and viewing the world around us we tend to also compare ourselves with others. These comparisons not only help us decide if we should conform to social expectations but also help us measure our performance against others and see if we exceed them or fall short. To compare ourselves against others is natural and can help to boost self-image by outperforming others and gaining status (Heffetz & Frank, 2011; Tajfel & Turner, 1979), motivate us to achieve by seeing what others above us are capable of (Festinger, 1954), or see if we you fit in with

those we consider our peers (Festinger, 1954; Schwartz & Bilsky, 1990).

Interventions and programmes such as PAYD insurance could therefore take advantage of the natural desire for comparison and provide information on the driving behaviour of their clients to each other in order for comparisons to be made. This could be done on an individual basis or by providing comparisons with what the average PAYD insurance driver of a similar peer group is doing. Comparisons could even be taken a step further by offering chances to compete and gain status or external prizes by outperforming others. However, this may not be a good idea as comparison and competition may actually lead to unwanted negative effects. Firstly, providing comparisons, particularly on an individual level, may raise privacy concerns which could lower the acceptance of PAYD insurance (Bolderdijk, Steg, & Postmes, 2012). These privacy concerns could be somewhat alleviated by offering customers an option to opt-out of comparisons or giving them control over who their data is compared against.

However, there are other problems than privacy with comparisons that must still be considered. As mentioned above in reference to normative influence, the provision of information about what others are doing can have unintended negative effects. Meaning that people who are performing worse than others may be motivated to perform better but those who are performing better may actually start to perform worse (Abrahamse et al., 2005; Lehman et al., In Press). This was exactly the case in a study of household energy use where providing information on the average energy consumption in a neighbourhood decreased the energy use of high users but actually increased the energy use of low energy users (Schultz et al., 2007).

Another risk is that while people do like being seen as higher than others, i.e. to gain status (Heffetz & Frank, 2011), they do not particularly like seeing others with higher status than themselves (Sundie, Ward, Beal, Chin, & Geiger-Oneto, 2009). Seeing others as having higher status than you is especially a problem if there is some kind of benefit or reward associated with being ranked highly, such as would be the case if competition was involved, and this can lead to resentment and disengagement with a task (Henderson et al., 2011). There is also some evidence that suggests that competition only motivates those at the top and can in fact have a negative demotivating effect on low performers (Bull et al., 1987; Dye, 1984). In other words, while competition may encourage those who feel they can win, those who feel they cannot win may simply stop trying and start to feel negatively towards the competition and the organisation running it. Furthermore, one study, where pizza drivers were given a competed with each other for a reward based on seatbelt wearing and good intersection behaviour, even found that winning the competition temporarily lowered the performance of the prize winners (Ludwig, Biggs, Wagner, & Geller, 2002). Another potential downside is that if someone has won or been ranked highly but then falls down the rankings or fails to win again in the future they may also become more dissatisfied than if they had never ranked highly or won in the first place (Henderson et al., 2011). That people can be extra unhappy about losing status after gaining it in the first place could be related to the idea that people are more sensitive to losses than gains (Kahneman & Tversky, 1979). The idea of loss aversion will be discussed further in the later framing section (Section 4.5).

Finally, the majority of drivers consider themselves to be safer and more capable drivers than the average population, which signals a strong optimism or self-enhancement bias amongst drivers (McKenna et al., 1991; McKenna, 1993). Therefore, if drivers were presented with comparative data via a PAYD insurance system that shows they are worse than average; this may challenge their strong beliefs about their own abilities. When such strong self-views are challenged drivers may act to preserve their self-image, not by changing it to reflect the new information, but rather by discrediting the source of the information and perhaps abandoning the PAYD insurance plan.

Therefore, in light of the above issues it seems that the provision of comparative information or competition within a PAYD insurance system may be a less than optimal option. If any attempt to do so was still carried out, perhaps due to customer demand, it would have to be carefully monitored as to not produce any unintended consequences.

## 4.4 Consistency, commitment, and goal setting

In general people like to believe that the way they are acting and behaving is consistent with that they believe. Furthermore, we generally expect others, whether they are individuals or organisations to also be consistent in this fashion (Cialdini & Trost, 1998). That people are motivated to be consistent and also expect it in others is likely why people often strongly believe attitudes towards driving are predictive of driving behaviour despite the evidence to the contrary (Rothengatter, 2002).

The internal need to maintain consistency is, according to social psychologists, driven by a need to maintain a positive self-concept, both in their own view and in the view of others (Cialdini & Trost, 1998; Cialdini, 2001), and/or to avoid cognitive dissonance. Cognitive dissonance (Festinger, 1957) is an uncomfortable feeling of tension that individuals experience when they perceive that they are not acting in a fashion that is consistent with their internal motivations. People generally wish to avoid experiencing cognitive dissonance and may even alter their behaviour ahead of time in order to prevent this unpleasant feeling

Behaviour change interventions can leverage this desire to be consistent by getting people to make commitments or set goals for themselves. This creates a commitment to future behaviour that, especially if the commitment is made or goal is set publically, people may work hard to avoid breaking (Cialdini & Trost, 1998; Cialdini, 2001). Commitments and goals could therefore be used in conjunction with a PAYD insurance package. For instance when signing up for PAYD insurance new customers could be given the option to commit to, and set a goal of lowering their insurance bill by driving safely and economically.

Such commitments and goals work better if they are made voluntarily (Cialdini, 2001), if the commitment is made in a more tangible form, such as writing (Lehman & Geller, 2004), and if the commitment is made publically (Cialdini & Trost, 1998; Cialdini, 2001). In terms of the public nature of the commitment it is possible that clients who signed up for such a commitment with PAYD insurance could be given a sticker or similar reminder that proclaimed them as a safe and/or eco-friendly driver (insured by PAYD). Another possibility would be to get them to publically commit to a goal via a social networking site or in some other fashion. Commitments and goals also work better if people are given feedback on their progress towards the goal, or reminded that they have not met a commitment (Abrahamse et al., 2005; Bagchi & Li, 2011; Lehman & Geller, 2004; Lehman et al., In Press). However, given the previously discussed problems with comparisons (Abrahamse et al., 2005; Henderson et al., 2011; Lehman et al., In Press), it is likely best that any commitments that are made or goals are made in reference to personal performance and not in comparison to other PAYD insurance customers. Furthermore, goals should be large enough to be worth the effort (Abrahamse et al., 2005), but small enough so that progress towards them is noticeable (Bandura & Schunk, 1981; Kivetz, Urminsky, & Zheng, 2006; Naylor & Ilgen, 1984). One way to achieve this large but near effect is to have a large goal set, say saving 30% on your next insurance bill with PAYD, which can be then made up with a combination of smaller sub-goals, such as earning a certain number of reward points in the next day.

One famous commitment tactic that relies on the need of individuals to be consistent is the 'foot-in-the-door' tactic (Freedman & Fraser, 1966). This tactic involves making a relatively small request of an individual, such as asking them to hold a pen for you, and then follow it up with a larger request, such as asking them to sign up for a PAYD insurance plan. The idea is that the small request is likely to be complied with, which then creates pressure to comply with the later, larger request in order to appear consistent and complete your dealings with the person or organisation involved (Burger & Caldwell, 2003; Freedman & Fraser, 1966). The foot-in-the-door tactic can, however, backfire if used too obviously as it then appears controlling and manipulative (Cialdini & Goldstein, 2004). Getting people to commit to a free trial of PAYD insurance may be one 'foot-in-the-door' tactic that could increase the subsequent sign on for a PAYD product.

The opposite of the 'foot-in-the-door' tactic is the 'door-in-the-face' tactic (Lehman et al., In Press). With 'door-in-the-face' an initial, large, proposal is made that is expected to be turned down. This is then

followed by a much smaller and now much more reasonable sounding request 'Door-in-the-face' may be more risky than 'foot-in-the-door' as it starts with an initial refusal. However, an example that could be used for PAYD insurance is a notification that base insurance rates are going to have to increase in order to cover the costs of high-risk drivers and then following this up with information on PAYD insurance and its lower costs. This may, however, still backfire if people have enough time to think about the situation and compare alternatives. In fact, both 'foot-in-the-door' and 'door-in-the-face' are most effective at times where people are tired, under time pressure, and working mostly automatically (Lehman & Geller, 2004; Lehman et al., In Press).

While commitments can work well there is also a risk associated with them. When an individual feels they are not meeting commitments then they will, as mentioned previously, likely experience the unpleasant sensation of cognitive dissonance (Festinger, 1957). When faced with cognitive dissonance people have two major options. They can change their attitudes and the way they think about the situation or they can change their behaviour. This means that in the face of information from a PAYD insurance system that their behaviour is not eco-friendly or safe rather than changing behaviour drivers may just change their view of themselves, i.e. that they don't need to be as safe as what PAYD demands, or of the information, i.e. that the information is biased or misleading. This may especially be a problem with driving behaviour as drivers generally overrate their driving ability and view themselves as safe drivers (McKenna et al., 1991; McKenna, 1993). As such, any information to the contrary may be threatening to their self-image of a good driver and cause them to disregard the information. Making commitments, at least appear, voluntary may lesson this as people tend to keep commitments they make themselves, and therefore change behaviour, more commonly than commitments that are not chosen voluntarily (Cialdini, 2001). Luckily, however, the above problem also can happen in reverse, in that just performing a behaviour can result in a change in attitudes and cognitions about that behaviour (Bem, 1972). So, in the case of PAYD insurance, just trying out a PAYD product may increase acceptance for it as found in the Buxbaum (2006) trial where those who had tried PAYD insurance had more positive attitudes towards it than whose who had not.

## 4.5 Framing

The way that information is framed, or how it is presented to people, can also impact their decisions. One such type of framing that is likely to affect PAYD insurance is loss aversion (Kahneman & Tversky, 1979). Loss aversion is the fact that, when considering options, people will work harder to avoid a loss than they will to get a gain. So for example people may try harder to avoid losing an already gained discount on insurance than they did to gain that discount in the first place. This aversion to loss is well established in studies where people are asked hypothetical questions (Tversky & Kahneman, 1981). In fact in such studies it has been shown that people state that they would try just as hard to save $15 on a $150 purchase as they would to save $5 on a $50 purchase. A finding that only further emphasises the economic irrationality of loss aversion and signals that people may work hard to get even small discounts.

However, decision-making in real life is not often carried out in the same way that it is when considering a hypothetical situation in an experiment. As such, it is also useful to look at real world experiments of loss aversion in reference to PAYD insurance. We are only aware of one such experiment which was carried out by Bolderdijk et al (2011) who found no impact of framing the money available through a PAYD system as either a loss or a gain. The finding of Bolderdijk et al (2011) could be, however, due to the fact that they relied on a website for communicating the information about the gains or losses. This means that people may not have been checking this website often and as mentioned previously feedback works best when given immediately and close to the behaviour that is meant to be effected (Skinner, 1974).

Furthermore, one risk of trying to use loss aversion is that loss may be interpreted as a penalty or punishment, the uses of which are generally advised against as they are not as effective as rewards

in motivating behaviour (Deci et al., 1999; Deci et al., 2001; Kohn, 1999; Skinner, 1974). However, it is still worth carefully considering loss aversion as a tactic to increase behaviour change under a PAYD insurance plan. If such a decision was made, one way to use loss aversion could be to start progress towards an insurance discount or bonus with already some discount amount received. So for example if there is a 30% discount possible, the starting discount could begin already at 15% and then gains could be made on top of that in addition to the chance to lose that discount. Such an approach has an advantage of also giving an idea that progress towards a goal (of a 30% discount) has already been made and may lead to people being more committed towards achieving the goal due it being already underway (Bandura & Schunk, 1981; Kivetz et al., 2006; Naylor & Ilgen, 1984). However, further research in this area is needed.

Separate from any loss framing, the tendency to try for a goal that has already been made closer (Bandura & Schunk, 1981; Kivetz et al., 2006; Naylor & Ilgen, 1984) could also be taken advantage of by creating an impression of illusory or false progress. To do this an insurance package could be priced so that it initially appears that anyone signing up as already received 10% off (just for joining) and can work for an additional 30% but will always receive the first 10%. However, in such a case the insurance has been priced so that the 10% discount is actually what would just be a normal price for insurance. This is the same trick used by coffee houses that initially give you two stamps towards their loyalty card for a free coffee, making you feel like you have already made significant progress towards that goal even though that this is not the case. However, this tactic could be viewed as deceitful if discovered by customers.

Another framing effect is to consider how a message is delivered. In the case of PAYD insurance there are expected benefits to the individual and society at large in terms of safety, the environment, and monetary savings. Given the large benefits for society it may be tempting to focus on these, however, talking about such societal benefits are more likely to be motivating for decision makers that can help implement PAYD than for individual customers. In terms of convincing consumers about PAYD, people are generally more responsive to smaller scale, personal and immediate, feedback on loss and gains (Abrahamse et al., 2005; Lehman et al., In Press; Slovic, Zionts, Woods, Goodman, & Jinks, 2011) so stressing the individual level benefits of PAYD is likely to be more effective. However, as mentioned several times previously drivers have a tendency to overestimate their driving skills so the majority of customers for PAYD insurance will already think that they are safe drivers. This may mean that messages about PAYD insurance resulting in safer driving may not be particularly effective if they concentrate on the behaviour of the individual who makes the decision to sign up for PAYD insurance. An exception to this is that the benefits of telematic based PAYD insurance could likely be sold as a safety device in the event of an accident that notifies the relevant emergency services and as a safety device in the event of car theft. In the case of accident alerting and theft protection these messages are framed in terms of threat removal and therefore reference the general risks on the road, not the individuals own behaviour, and are less likely to threaten an individual's self-image as a safe driver.

Another exception could be if PAYD insurance is being marketed towards the parents of young drivers. In this case the safety benefits are for their children, rather than the parents themselves and therefore will again not threaten the self-image of the parents but reassure them that their child will be protected. However, while such marketing might work on parents, it may be resented and be seen as controlling by the young drivers themselves (Gesser-Edelsburg & Guttman, 2013). Such resentment may in turn not result in much loyalty to the insurance product in the long run. In other words, PAYD insurance forced upon a young driver by a parent may be seen as a restriction to escape. Given that the parents may be also paying for the cost of insurance the young driver would also be unlikely to directly experience any of the financial benefits of PAYD, leaving only the negative aspect of being monitored. As such, it may be better to focus individual level PAYD messages on the monetary benefits for the individual, and if relevant, their family.

The monetary benefits of PAYD insurance do not threaten the safety image of the driver rather they boost the image of the driver as being skilled and intelligent enough to save money for themselves.

However, as mentioned in the rewards section monetary benefits do have to be big enough to motivate people. Also, feedback on how to gain, and the receipt of, these benefits should be given in a clear and immediate fashion (Skinner, 1974). That monetary benefits must be big enough could potentially be a problem for PAYD insurance when combined with immediate feedback as the moment to moment monetary gain is likely to be small. Plus, even the monetary gain over a larger time period may not be large. As mentioned in the rewards section of this report (Section 3) one solution to deal with the problem of small monetary amounts is to use another medium, such as points, which can vary more freely and therefore provide richer feedback to the drivers (Bagchi & Li, 2011; Hsee et al., 2003).

The final way in which the benefits of PAYD insurance could be framed is in terms of environmental gains. Environmental gains can be hard to communicate as they are a large scale societal issue. However, in modern times acting (or to be seen to be acting) in a pro-environmental fashion can be a pleasant and motivating experience for some people, especially women, it seems (Delhomme et al., 2010; Polk, 2003). As such, some researchers have suggested that feedback on how driver behaviour is effecting the environment may be more motivating than stressing small monetary gains (Bolderdijk, Steg, Geller et al., 2012; Delhomme et al., 2010). For instance, Bolderdijk, et al. (2012) argue that pro-environmental messages are more effective as they allow a person to see themselves as a good, moral, decision maker. Whereas framing benefits in a monetary fashion may lead people to see themselves as motivated by money, which in turn may be associated with greed. However, the research around the claim that pro-environmental messages may be more effective is still relatively new, so care should be taken with using such an approach. It may be, for instance, that the effects are related to novelty as people are not used to being given direct information on the environmental impact of their actions and therefore the effectiveness of such messages may wear off over time (Delhomme et al., 2010). It is also possible that pro-environmental information may be motivating for some people but not for others. Therefore, for now it may be safer to combine pro-environmental messages with information on monetary saving, perhaps represented as point gain to break the immediate connection with money and therefore with greed. It may also be that pro-environmental messages could be more effective at encouraging signing up to PAYD insurance, whereas momentary feedback on monetary saving may be better for changing behaviour when driving, or vice versa. However, more research in this area is needed.

## 4.6 Prompts and modelling

Prompts are simply reminders or instructions to perform certain behaviours and modelling is the provision of a demonstration on how to perform behaviours. Prompts, therefore, are most useful when a behaviour is already known, relatively simple and easy to perform, shown when the target behaviour can be performed, and if stated in a polite and non-controlling fashion (Lehman & Geller, 2004). As such, prompts can remind or alert individuals to the expected social norms or provide information that could otherwise be missed. An advisory ISA that alerts drivers when they exceed a speed limit is an example of a prompt (Regan et al., 2003). Within PAYD insurance prompts could be given via immediate in-car feedback on current behaviour and the associated costs and benefits. In addition just the obvious presence of a PAYD system within a vehicle may have an effect of reminding drivers that their behaviour is being monitored.

Modelling on the other hand is better for complex behaviour and for demonstrating how a reward or penalty system will operate (Abrahamse et al., 2005; Bandura, 1967; Lehman et al., In Press). In effect modelling, particularly when combined with a reward, clearly demonstrates what behaviour is desired and how it will be encouraged, which allows for observational learning (Bandura, 1967). In the case of PAYD insurance modelling is likely to not be useful in the vehicle but instead could be provided via online videos or driving simulations showing how a PAYD insurance system would operate. Such modelling should always be accompanied with showing the positive consequences of behaviour rather than focusing on the negative.

## 4.7 Reciprocity

Reciprocity is the simple notion that people tend to feel that if someone or some organisation does something nice for them then they should do something nice for that person or organisation (Cialdini & Goldstein, 2004). In terms of PAYD insurance the desire to reciprocate can be taken advantage of by offering small free gifts when people sign up for PAYD or along with any offers of joining a PAYD insurance package. Providing a free trial of PAYD could also engender feelings of reciprocity. Particularly if a usual 'fee' or other cost is initially highlighted and then waved before the trial begins.

# 5. Gamification

Before moving on to the final section of this report we wish to briefly discuss the idea of gamification, which is a term that has recently gained popularity (Deterding et al., 2011). At its most basic level gamification is sometimes referred to as adding game elements to a non-game activity. The idea is that since people enjoy playing games that the addition of game elements to a task, such as driving safely, may provide additional motivation for people to perform this task. Indeed, anecdotal evidence from studies that have looked at providing in-car feedback on eco-driving (e.g. Barkenbus, 2010) or safe driving (Mazureck & van Hattem, 2006) show that some proportion of people will use in-car feedback, such as could be provided by PAYD, as part of a 'game'. For example people report things like making a 'game' of seeing how long they can drive while keeping a feedback icon in the 'green' or by going as far as possible using only the battery of a hybrid vehicle.

These above examples are different from gamification though, as they represent people voluntarily and spontaneously making a 'game' out of feedback that has been provided to them for a different purpose. Essentially what the people above are doing is playing with existing systems and finding motivation and fun there for themselves. Gamification on the other hand is the deliberate addition of game design elements into a task (Deterding et al., 2011). As such, gamification usually takes the form of adding game elements such as external rewards (e.g. points, money, or brightly coloured badges) for performing tasks, the addition of 'quests' (goals and commitments), and/or the addition of competitive and comparative elements. All of which are nothing new. In fact, in many ways gamification, much like 'nudges' (Thaler & Sunstein, 2008), is just a rebranding of well-established behavioural and social psychology ideas. In the case of gamification this rebranding is also being done in an attempt to associate gamification with the modern popularity of computer games and therefore with fun. However, gamification, in itself, has no real association or guarantee of producing fun or play and does not necessarily turn the activity into a game (Deterding et al., 2011). That is to say that just adding external rewards and comparisons to a non-game and saying it has now been 'gamified' does not necessarily make the activity fun or a game and therefore such additions may have no motivational effect. For example, a recent study conducted over 1.5 years looking at the gamificaiton of a web based marketplace used by over 3,000 users found that there was no overall increase in the use of the service in relation to the addition of the gamification elements (Hamari, 2013).

Furthermore, many of the ways that gamification can be implemented are actually potentially negative, i.e. the addition of competition and comparison can actually demotivate people (Abrahamse et al., 2005; Henderson et al., 2011; Lehman et al., In Press). As can the provision of required and therefore controlling external rewards and goals (Cialdini, 2001; Deci et al., 1999; Deci et al., 2001). Gamification, unless very carefully done, also misses several main motivating factors of games, i.e. that they are usually entered into voluntarily and that they are fun. Gamification therefore, if it is to be implemented should take care that any 'game design' system used is voluntary, meaning that customers either opt-in or out-out of such a system, and that the negative effects associated with the behavioural and social tactics that gamification rebrands are avoided. Care should also be taken with gamification as there may also be a novelty element to it that will wear off. Certainly, further research into gamification approaches and their long term effects is need.

# 6. Conclusion and recommendations for PAYD insurance

The strength of PAYD insurance is ultimately in its ability to add much needed behavioural feedback to the driving task. By this feedback PAYD insurance can help to correct a major issue with driving; that safe and eco-friendly behaviour is often unrewarded, whereas the consequences for unsafe behaviour are rarely negative and can actually often be positive (Fuller, 1984; Fuller, 1992; Näätänen & Summala, 1974; Rothengatter, 1988). The potential to provide useful feedback is strongest for PAYD insurance systems that make use of a telematics system. Telematics increase the certainty and swiftness with which target behaviour can be detected which is in line with good behavioural guidelines for providing feedback and rewards (Skinner, 1974). Likely candidates for behaviour are speeding, distance travelled, changes in acceleration, location of driving, and time of driving. Additional bonus services such as accident reporting, theft protection, and advisory ISA could be optional extras on top of, or included with, a telematics PAYD system in order to make PAYD look more attractive. Phrasing these additional options as 'free extras' for signing up with PAYD insurance may help encourage the acceptance of PAYD insurance by increasing liking and encouraging reciprocity (Cialdini, 2001; Cialdini & Goldstein, 2004). Adding advisory ISA to PAYD insurance is particularly attractive as advisory ISA has been found to decrease average driving speeds by as much as 5 km/h (Brookhuis & de Waard, 1999; Lahrmann, Agerholm, Tradisauskas, Berthelsen, & Harms, 2011; Päätalo, Peltola, & Kallio, 2002; Sundberg, 1999).

Many current PAYD insurance systems provide feedback on driving via a web based interface (see section 2). This is not optimal, as such websites must be voluntarily checked by the client, away from the driving task, and the actual reward for behaviour is not received until months later when an insurance bill arrives. Therefore, receiving the reward and feedback on behaviour is delayed and many people may not even check these websites. An obvious solution to this is to provide immediate in-car feedback on both the rewards being received and the behaviour that is producing the reward. If provided in a clear, non-distracting, and immediate fashion, in-car feedback would meet all the requirements of a good reward intervention (Abrahamse et al., 2005; Bolderdijk, Steg, Geller et al., 2012; Skinner, 1974).

In addition to an in-car device there is still some use for a website for feeding back data collected by telematics based PAYD insurance. Such a website should focus more on providing aggregate information on consumers driving, e.g. total miles driven, total fuel saved, and so on. What information to provide should also be guided by surveys of clients but care should be taken to present the information, both on the website and in-car, in a clear, non-judgemental, non-controlling, polite fashion. Such information should not, therefore, be used to castigate or admonish a driver for bad behaviour as this may reduce the effectiveness of PAYD insurance (Brehm, 1966; Deci et al., 1999; Deci et al., 2001; Skinner, 1972). Rather advice and modelling should be provided as to how they can improve and save themselves money on their insurance (Abrahamse et al., 2005; Bandura, 1967; Deci et al., 1999; Deci et al., 2001; Lehman et al., In Press). In other words, the stress should always be on what the driver **can do**, not what they should not be doing. Furthermore, the issue of whether to present information framed in terms of monetary savings, environmental impacts, or safety impacts needs further research (Bolderdijk, Steg, Geller et al., 2012). For now, it may be best to use all three, although again they should be presented non-judgementally and care should particularly be taken with safety messages as drivers tend to view themselves as already being safe (McKenna et al., 1991; McKenna, 1993). These optimism biases mean that messages that suggest that their driving behaviour is unsafe could be dismissed by drivers or cause them to disengage with PAYD insurance. It may be best to also mostly focus feedback on the insurance savings and the behaviour that is causing them and leave feedback on safety or the environment to optional panels or tabs on a website. By making feedback on the environment or safety optional it means that those who are interested could check it. But that at the same time such, potentially more judgemental, information would not be forced upon all customers.

It is also possible that a PAYD website could be used by drivers to set goals for themselves. It would also be useful to give customers the option to publically share these goals, as public commitments to goals are generally more effective (Cialdini & Trost, 1998; Cialdini, 2001). Although sharing their goals and progress should only be relatively unobtrusive and not be forced upon customers. That said, it may be useful if customers who sign up to PAYD insurance are given some kind of reminder that they have committed to lowering their insurance costs/saving the environment/making roads safer. Perhaps

in the form of a sticker or something similar that they could voluntarily chose to put on their vehicle. Again, such public commitments have been found to increase the effectiveness of behaviour change programmes as they serve to remind people of the commitment they have made and enhance feelings of wanting to be consistent with that commitment (Cialdini & Trost, 1998; Cialdini, 2001). A PAYD insurance website could be further enhanced by providing regular, e.g. monthly, email summaries of certain positive aspects of driving behaviour. Such email summaries will also serve as prompts to visit the website but should also be able to be opted-out of in case they are viewed as nuisance or too controlling.

However, based on the literature, what PAYD insurance data should not be used for comparisons with other PAYD customers on either on an individual or aggregate basis. Such comparisons risk demotivating those who are not doing well, or providing unintended normative information that may actually encourage bad behaviour (Abrahamse et al., 2005; Bull et al., 1987; Lehman et al., In Press).

Care should also be taken when designing the aesthetics and usability of a PAYD insurance website and any associated in-car interface in order to take advantage of the 'halo effect' (Thorndike, 1920). Effectively, the 'halo effect' means that an interface that is easy to use and attractive will enhance not only the positive experiences that customers will have interacting with the system but also how effective and worthwhile they perceive the system to be.

In terms of the reward structure of a PAYD system, rather than being specifically charged a set amount per kilometre driven it may be advisable that clients are instead working towards a certain discount off their next insurance bill or renewal. This means that the focus is on gaining or losing a future discount, rather than gaining a charge that will eventually have to be paid. By having people gain a discount, this may frame PAYD insurance as a reward to be earned rather than a punishment to be avoided. In addition, by working for a discount, it means that clients will have the perception that they will never be charged more than a set amount for their insurance.

That there is a set maximum and set minimum that clients will pay will also help reduce the cost of PAYD on insurance companies and make the forecasting of future income easier (Adkins, 2004; Bordoff & Noel, 2008). However, the effectiveness of a discount system in PAYD is largely unknown, as most estimates of the impact of PAYD insurance are based on a more direct mileage charge (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2011; Zantema et al., 2008). On the other hand, once PAYD insurance has become wide spread, or if it was government mandated rather than voluntary, then a truly flexible insurance package where what drivers pay is based on their directly driving, including extra charges, could be implemented.

The use of telematics does mean that privacy concerns related to PAYD insurance will inevitably be raised. These can be lessened by stressing the benefits of PAYD (Bolderdijk, Steg, & Postmes, 2012) and providing strong, credible, assurances that all data will be kept secure and not shared with outside agencies. With the exception of data that may help in the case of an accident or theft. Related to privacy concerns, it also appears that offering a trial period in which customers can experience PAYD insurance for themselves may be valuable. Such a trial period may create a feeling of commitment (Cialdini, 2001; Cialdini & Goldstein, 2004; Lehman & Geller, 2004; Lehman et al., In Press), helps demonstrate the benefits of PAYD insurance (Bolderdijk, Steg, & Postmes, 2012), and may increase feelings of reciprocity and liking towards an insurance company (Cialdini, 2001; Cialdini & Goldstein, 2004) . All of these factors should help lesson any privacy concerns and additionally also help increase the acceptance of PAYD insurance with potential customers. Furthermore, to increase acceptance it is recommended that insurance companies work closely with government and external experts to provide soft, or expert, information on the benefits of PAYD insurance to society at large as well as to individuals (Cialdini & Goldstein, 2004). Such opinions may be more credible if coming from an outside source as there may be a perception that any new product an insurance company introduces must be only for self-serving profit based motives. In addition, due to the costs involved there may be a need for governments to assist insurance companies in setting up PAYD (Adkins, 2004; Bordoff & Noel, 2008; Litman, 2011).

Finally, additional research on PAYD Insurance both in lab settings and via large on-road trials is needed to give further directions on the way forward. Potential areas of interest, apart from the previously mentioned type of message (economic, safety, or environmental) could be looking at different types of reward (e.g. points versus money directly), how much reward is needed (Gneezy & Rustichini, 2000), if loss aversion is effective or if is perceived as a penalty (Deci et al., 1999; Deci et al., 2001; Kahneman & Tversky, 1979; Kohn, 1999; Tversky & Kahneman, 1981), what data are customers most interested in, if PAYD insurance reduces intrinsic motivation to drive safely (Cameron & Pierce, 1994; Cameron et al., 2001; Deci et al., 1999; Deci et al., 2001; Kohn, 1999) or creates negative behavioural adaptation (Fuller, 1984; Näätänen & Summala, 1974; OECD, 1990; Wilde, 1976), and if variable ratio schedules of reinforcement, where rewards are somewhat unpredictable can be effectively used in PAYD insurance (Skinner, 1974).

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# **Behaviour change and Pay-As-You-Drive insurance:** Rewards, punishment, and persuasive information delivery

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