Work-related influences on marital satisfaction amongst shiftworkers and their partners

A 39-year-old operator in the coal industry put it to us very simply. ‘My wife and I don't seem to spend any time with each other because I’m also at work or on night shift and the "cranky" me comes out’, he wrote, adding ‘My marriage is turning to shit’. He was not the only one. A 35-year-old fitter told us ‘I blame the roster and the hours I work for my recent marriage breakdown, a very stressful time with three young children involved’. It gives urgency to the need for some serious examination of the interaction between shift work and marriage with the caveat that we found that not all shiftworkers are in unhappy relationships by any means, and many cite the resultant ‘blocks’ of leisure as a reason for choosing shift work (where a choice is involved). So it prompts us to ask: how do shiftworkers’ jobs affect their own lives and those of their partners, and in turn affect their marital satisfaction? Researchers into marital interactions frequently made use of couples-level data, and variously examined spillover effects (work intruding into one’s own personal life) and occasionally crossover effects (work of one party intruding into the life of the other), and sometimes examined relations in the context of shiftwork, but rarely have these issues been examined through the use of a large-scale, matched-pair study. This issue is particularly important considering the growing ability of employers to determine working hours and the consequent increasing emphasis on shiftwork, rationalized by reference to a ‘24/7’ culture. This is most strongly evident in the mining industry, where eight-hour days shifts have, within recent decades, been replaced by rotating twelve-hour shifts. Our study takes that industry as its case study and uses a large-scale matched-partner technique to examine the impact of work

on marital satisfaction. We use the term 'marital satisfaction' to refer to both formally married and 'de facto' relationships.

Literature

Spillover theory has been a dominant paradigm in understanding work-family interaction (Eby, Maher and Butts, 2010). Work is assumed (but not exclusively) (e.g. Hanson and Hammer, 2006) to exert a negative influence on the domestic domain. Crossover effects are considered more complex, (Song, Foo and Uy, 2008; Ilies, Wilson and Wagner, 2009). Shift work adds more complexity to crossover and spillover theory in that in addition to the other mechanisms whereby work can impact on home life, the lack of synchronicity between the work of one partner, and the work of the other, can directly and indirectly affect partners' exposure to each other. Studies of marital satisfaction and crossover and spillover effects are evolving, with recent reports looking at employed/unemployed dyads and daily stressors (Song, Foo, Uy and Sun, 2011), and two recent theses that examined the relationship between work and intimacy levels (Ottusch, 2013) and emotional exhaustion (Oscharoff, 2011). This current study is a much larger exploratory examination of spillover and crossover effects of work on marital satisfaction than hitherto conducted, and includes a more complete suite of work variables.

Empirical *couples*-level research into marital satisfaction and work has a long history. An early study by Hamilton (1929), like a number of other early studies, was ambitious, involving up to 30 hours of questioning of individual participants on a myriad of variables including work. While interview lengths may have shrunk, some of Hamilton's innovations have survived. He was the first to assign a numerical scale derived from a multi-item list to marital satisfaction (MSAT) (Terman and Johnson, 1939), and his matched pair research

itself has thrived, offering as it does a means to overcome the positive illusions characteristic of individual reporting (Taylor, Shelley E, 1989; Murray and Holmes, 1997). Hamilton's core research question, was what Gottman and Krokoff (1989) called "the oldest question" in the research on marriage—what determines marital satisfaction?— and that remains the focus of this paper.

While many of the matched pair studies target work-related variables, they do not directly tap MSAT (Jackson, Zedeck and Summers, 1985; Barnett, Marshall, Raudenbush and Brennan, 1993; Lavee and Ben- Ari, 2007; Green, Schaefer, MacDermid and Weiss, 2011). Job role quality has been associated with psychological distress and marital role quality (Barnett et al., 1993). One of the best and largest couples-level studies was published in this journal (Barnett, Gareis and Brennan, 2009), examining dual-earner couples and finding evidence in support of Jacobs and Gerson's (2001) 'overworked families' hypothesis—that is that the combined workload of partners needs to be taken into account in assessing the quantum of relationship strain. Their finding illustrates the need to examine MSAT in a system context.

Our study is one of the largest couples-level studies examining MSAT in the context of shift work—a work format that is becoming more common internationally (Taylor, P.J. and Pocock, 1972; Munakata et al., 2001; Alford, 2009; Hansen and Stevens, 2012). It examines, the role of shift work, in mining families and looking at both crossover and spillover effects in relationships where either or both the couples work. In Australia, miners now include the highest proportion of male shift workers (Australian Bureau of Statistics, 2010). A disproportionate numbers of these miners work are at sites distant from the family home (e.g. Western Australian Chamber of Minerals & Energy, 2005), either using a long-distance commute (LDC) by car, or fly-in-fly-out (FIFO) practices and maintaining 'homes' both near the mine, and in their communities of origin. A number of studies have pointed to the

adverse effects of long or rotating shifts on matters such as health, tiredness, fatigue and wellbeing (Folkard, S and Lombardi, 2006:1; Wang and Chuang, 2014; Da Silva, 2006) and these all point to the potential for shift work to create interference in home life and potential issues for marital satisfaction.

Another issue in marital satisfaction that has potential relevance in the context of shiftwork is 'morningness' (being a 'morning person'). Morning or evening 'types' differ on a number of strata other than sleep-wake patterns, including biological rhythms (including temperature and hormone fluctuations) (Kerkhof, 1985; Van Hulle, Shirtcliff, Lemery-Chalfant and Goldsmith, 2012), and tolerance to shift work Saksvik, Bjorvatn, Hetland, Sandal and Pallesen, 2011. Studies have differed in whether they find synchrony in morningness or eveningness does (Larson, Crane and Smith, 1991; Hasler, 2009) or does not (Randler and Kretz, 2011) lead to greater relationship satisfaction. Circadian rhythms have significant theoretical implications for the shift work sector. Greater tolerance for more variable sleep patterns is said to be more common amongst 'morning' persons, (Ishihara, Miyasita, Inugami and Fukuda, 1987), offering an advantage to those facing threats to a steady circadian rhythm. The majority of adults sleep with a significant other (Troxel, Robles, Hall and Buysse, 2007), and disrupted sleep appears to be associated with marital quality outcomes (Hale, 2005).

Ranges of studies indicate that day workers experience greater job and marital satisfaction and social integration (Frost and Jamal, 1979; Khaleque and Rahman, 1984; Simon, 1990; Newey and Hood, 2004). In a shift work context, amongst relatively newly married men with children, working fixed night shifts made divorce six times more likely than for those working days only (Presser, 2000). An extension of the Presser study, using data from the National Longitudinal Survey of Youth in the US, found that night shift work amongst wives,

though not husbands, predicted divorce (Kalil, Ziol- Guest and Levin Epstein, 2010). This again highlights the benefit of accounting for both partners in analyses.

That shift work is detrimental to marital quality has an *a priori* logic that has tended to discourage careful empirical work, and the studies that have taken place tend to support this common-sense notion (Hughes, Galinsky and Morris, 1992; Perry- Jenkins, Repetti and Crouter, 2000; Rogers and May, 2003; Mills and Täht, 2010). White and Keith (1990) in a large three year study of US panel data found that shift work had a "modest but very general negative effect on [every indicator of] marital quality" (p. 453). However, not all studies support this bleak picture (Täht and Mills, 2012). A majority of studies tend to find that the impact of rotating/night shifts on relationship quality is greater for women (Raudenbush, Brennan and Barnett, 1995; Perry- Jenkins, Goldberg, Pierce and Sayer, 2007), though there are exceptions (e.g. Barnett, Brennan, Raudenbush and Marshall, 1994; Rogers and May, 2003; Keizer and Schenk, 2012).

Evidence suggests that as marriages endure, they become more stable, but less happy (Vaillant and Vaillant, 1993), with relationship quality reported by one partner tending to track that reported by the other in longitudinal analyses (Keizer and Schenk, 2012). Strong predictors of MSAT are scarce. Relatively few studies have focused on work/relationship crossover effects more broadly. This study addresses these gaps in the literature, using the model shown in Figure 1, also examining the degree to which some sleep-related variables helps determine marital satisfaction as well as what elements salient to shift work independently predict MSAT in the key subpopulation of shiftworkers with access to a broader range of work-related variables than previously included in marital satisfaction studies.

Our study investigates the way in which shiftworkers' jobs affect aspects of the lives of both shiftworkers and, through crossover effects, their partners, which in turn affect their respective levels of marital satisfaction. Broadly speaking, those jobs may have an impact on marital satisfaction by affecting internal relationships within households or 'home life' (through creating interference or imbalances between work and life), or by affecting external relations (including the support parties receive from friends and workmates, which may ameliorate or exacerbate internal tensions) or by affecting physiological or psychological factors (such as sleep patterns or psychological health). The relations modelled are shown in Figure 1 below. We can think of crossover effects as being measured in one of two ways. What we call 'primary crossovers' occur when the partner forms views about their spouse's shiftwork (for example, that they interfere too much in the spouse's ability to do things around the house) and these views affect their marital satisfaction. Primary crossovers are shown on the left hand side of figure 1. These primary crossovers can be measured internally within a survey of partners. 'Secondary crossovers' occur when an attitude or behaviour of the spouse, that directly or indirectly flows from work, affects marital satisfaction of the partner. They are shown on the right hand side of figure 1. Secondary crossovers are measured by linked worker-partner surveys, in which variation in the dependent variable in the partner survey (marital satisfaction) is explained by variables in the (shift)worker survey. The terms are not meant to signify the supremacy of 'primary' over 'secondary', as the distinction is more for measurement than conceptual purposes, because some aspect of the partner's views on their spouse's work will result simply from the impact it has on the spouse's attitudes and behaviour. Relatively few studies have focused on work/relationship crossover effects on marital satisfaction, either broadly or amongst shiftworkers, and this study addresses that gap in the literature.

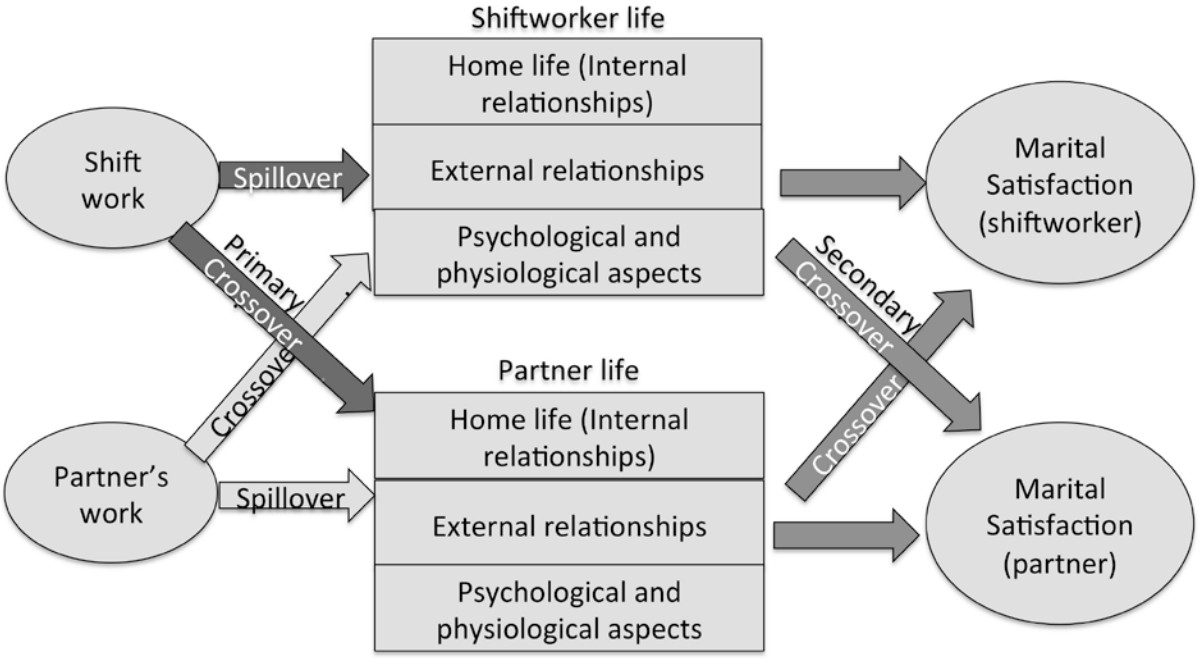

Figure 1 – Spillover and crossover effects between work, household and marital satisfaction

Our study therefore seeks to address a series of questions, in particular:

- what work-related factors most influence marital satisfaction amongst shiftworkers? Do variables such as insecurity and safety perceptions directly or indirectly influence marital satisfaction?
- is marital satisfaction in shiftworker couples influenced by work-life interference amongst shiftworkers, and if so in what ways? For example, are the effects most prominent for shiftworkers or their partners? Are the work factors of the shiftworker or the partner more important, or do neither matter?
- what sorts of crossover effects, if any, are there from shiftworkers onto partners (and vice versa), that affect marital satisfaction?

- how do sleep-related variables, such as sleep disturbance and morningness, influence marital satisfaction?
- what role, if any, do social networks and psychological health play in explaining marital satisfaction in shiftworker households?

Method

The Australian Coal and Energy Survey (ACES) is a longitudinal study with a matched partner design. The instruments comprise an extensive 16-page survey for mining and energy workers (referred to in this study as "shift workers") and a 12-page survey for their spouses (referred to as "partners"). Wave 1 of the study (late 2011), which is examined in this paper, is the largest formal longitudinal deployment of a battery of instruments known as the Standard Shift work Index (SSI) (see Tucker and Knowles, 2008 for a review). Beyond demographic variables, it contains extensive physical, psychological and social health measures in addition to work and sleep variables. From the perspective of the current study, notable inclusions are work-life balance questions from the Australian Work and Life Index (AWALI) (Pocock, Williams and Skinner, 2007) and elsewhere (Gutek, Searle and Klepa, 1991; Allen, Loudon and Peetz, 2005) and questions from the Horne & Östberg morningness-eveningness questionnaire (MEQ) (Adan and Almirall, 1991). Questions on job insecurity, autonomy, child care, and life satisfaction were extracted from the Household, Income and Labour Dynamics in Australia (HILDA) survey (Watson and Wooden, 2002), while social involvement questions were taken from the World Values Survey (European Values Study Group and World Values Survey Association, 2006) along with a series of measures designed and piloted specifically for this project relating to shift work and long distance commuting. Respondents were contacted prior to the commencement of dispatch of the survey

instruments by telephone to ascertain willingness to participate and gain partner details. They were then mailed packages that included either single (shift worker) or matched pair (separate shift worker and partner) instruments.

Wave 1 of ACES includes data from over 4500 people, comprising 2639 mining and energy workers who were members of the CFMEU, and 1961 partners, of whom most (1798) were matched to specific members. Response represented response rates of 28% amongst eligible energy and mine workers and, amongst those partners to whom surveys were sent and whose spouses participated, 78%. Results are reported *only* for households where the mine and energy worker in the main survey worked two or more shifts (ie day-only or night-only workers were excluded). As a convention, and to avoid confusion, we use the term 'spouse' when discussing the partner's own partner that is the shift worker.

This article makes less use of items that explore the content of marital interactions which dominate the literature (Gottman and Krokoff, 1989; Bradbury, Fincham and Beach, 2000), and more of work-specific factors. Our study includes a bank of measures of social impact and engagement, worker and partner sleep, with the shift-worker survey including a substantial bank of measures from the recognised Standard Shift work Index (SSI) (Folkard, S. et al., 1993; Barton et al., 1995). It explores, in particular, responses to questions that were identical in both the shift-worker and partner iterations of the survey. Like the SSI and Barnett et al's study of matched pairs (2009), we include a recognized measure of psychological distress. Additionally, our instrument includes validated personality scales, and a subset of the Morningness-Eveningness Questionnaire Horne and Ostberg, 1976. We have used the full seven-item Revised Dyadic Adjustment Scale (RDAS) (Spanier, 1976; Sharpley and Rogers, 1984) which has been found to accurately categorize the majority of distressed marriages as at-risk. The question wording allows for reference to both formally

recognised marriage and de facto relationships. Tables signify relationships significant at the 5% or 1% levels, and these levels are also what define 'significant' in the text. Where relevant and informative we also sometimes refer explicitly to 'weakly significant' effects (those only applying at the 10 per cent level).

Data

Demographics

Given the nature of the mining and energy industry, the shift worker/partner categories were split along gender lines, with shift workers 96.3% male, and partners 96.1% female. A majority of the partners (70.3) worked outside their household, with 41.1% of partners working part-time, and 28.2% full time, with 18.8% of shift workers working as FIFO or LDC workers. Mean age of the shift worker was 48.6 (s.d. 10.2), whilst their partner was slightly younger (mean=46.7, s.d. 10.28). A matched pair comparison of shift worker marital satisfaction (Shft-MSAT) and partner marital satisfaction (Ptnr-MSAT) confirmed the weight of the literature showing that men tend to be more satisfied with their marriages than women Kogan et al., 2013. Shift worker RDAS scores (M=30.6) were significantly higher than partner scores (M=29.6) (paired $t_{(1456)}=6.675$, $p<.001$), that is, shift workers showed the most marital satisfaction. Some additional demographics are listed in Table 1.

Table 1: Selected demographics in the ACES matched pair sample.

Highest level of education #			Age group #			Weekly income#*		
	Shiftworker	Partner		Shiftworker	Partner		Shiftworker	Partner
Primary schooling only	1.1%	0.6%	20-29	4.2%	5.5%	< 500	0.1%	17.8%
Some secondary	26.5%	17.0%	30-39	17.5%	21.0%	501-1000	1.7%	51.6%
Completed secondary	21.3%	26.6%	40-49	26.3%	28.7%	1001-1500	7.4%	15.9%
Some additional post-secondary	49.2%	39.7%	50-59	38.2%	35.9%	1501-2000	21.0%	8.1%
Degree or postgraduate degree	1.9%	16.0%	60-69	13.6%	8.7%	2001-2500	41.2%	4.1%
			70+	0.2%	0.2%	2501+	28.6%	2.4%
Total N	1602	1755	*Total N*	1730	1737	*Total N*	1565	860

Missing data not reported * Australian dollars

Principal component analysis

Preliminary bivariate analysis revealed a number of clusters of variables that were significantly related to either Shft-MSAT or Ptnr-MSAT. To reduce the complexity of the multivariate modelling, principal components analysis (PCA) was used to produce a number of key, *a priori* factors. For the multivariate analyses, some single item measures, where appropriate, were retained, including age, income, work hours, and highest level of education. Combined household income did not predict either shift worker or partner MSAT in bivariate analysis, so member income, for which there were fewer missing data, was used throughout. In addition, factors from existing scales, including morningness and GHQ were used to reduce the data.

Shift worker variables

A single factor was extracted from safety climate items (9 items, α=0.786). For shift worker social support, two factors emerged, one associated specifically with union support (four items, α=0.916) and the other reflecting broader social support (3 items α=0.691). The latter was more influential and so was included in regressions. It included items on whether the

respondent had someone to cheer them up or help them, and also whether, at work, they could depend on people to help. Standard scoring of the morningness scale was used to create a single morningness variable for each participant, including partners. (Additionally, we calculated a synchronicity index as the absolute value from deducting partner scores from shift worker scores, but this was less useful than morningness itself.)

A single item measure of sleep disturbance was created using items from the Standard Shift work Index. Only those items that were relevant for a shift workers actual shift patterns (e.g. night shift items only for shift workers who worked only nights), were used to create a weighted average of sleep disturbance for each participant. A satisfactory single item measure of shift worker work-life balance (10 items, α=0.859) was extracted.

Partner variables

Turning to partner items, in some cases insufficient information existed to conform with PCA conventions for factorisation, however composite scores were calculated for job satisfaction (4 items, α=0.501), work stability (based on the presence of shifts, night work or weekend work) (3 items, α=0.722), sleep (3 items, α=0.761), and sense of control over work (9 items, α=0.867). A two-factor solution emerged for work life balance, one reflecting the partner's share of household work (that is the balance of work within the household) (3 items, α=0.583), and the other reflecting more conventional work-life balance (5 items, α=0.726). Partner's satisfaction with their spouse's work produced a reliable single factor solution of 12 items (α=0.859). Descriptives of the variables used in regressions are in the data appendix.

Analysis

Correlation analysis pointed a number of work related variables that appeared to have significant spill over and crossover impacts, notably the social/support variables. Work variables had stronger correlations with marital satisfaction, particularly for partners, than did demographic variables.

Multiple regression analyses were then employed around a number of models based on Figure 1 and using variables that emerged from the bivariate analysis, with the sequences designed to capture logical clusters of independent variables (IVs). Preliminary analysis suggested that some variables (for example, those measuring control, work stability, union support, work hours, number of shifts) had insufficient separate impact on marital satisfaction once other variables were held constant, indicating their effects were principally felt through other variables, particularly those measuring such things as work-life imbalance and the like. These variables were therefore not included in the final regressions shown, to allow maximum power in the model, as list wise deletion of cases with missing variables would otherwise lead to very small Ns.

Direct effects on shiftworkers

Table 2 Direct effect regressions predicting shiftworker marital satisfaction with shiftworker variables

Equation no:	(3.1)	(3.2)	(3.3)
Chance of being sacked	-0.2015**	-0.1847*	-0.1471#
	(0.076)	(0.086)	(0.087)
Shiftworker Support	1.2879**	1.3889**	1.3156**
	(0.170)	(0.190)	(0.193)
Work risk climate	0.0305	-0.0873	-0.0366
	(0.194)	(0.214)	(0.218)
Work-life imbalance	-0.6451**	-0.6229**	-0.5953**
	(0.206)	(0.226)	(0.228)
Shiftworker Sleep disturbance	-0.4074	-0.0246	0.1002
	(0.310)	(0.352)	(0.361)
Shiftworker Morningness		0.1963	0.1870
		(0.185)	(0.186)
Shiftworker Psychological ill health			-0.2530**
			(0.082)
Shiftworker Age		-0.0459*	-0.0478*
		(0.019)	(0.019)
Presence of children		-1.1044**	-1.0540**
		(0.380)	(0.383)
Shiftworker Wage ($'000)		0.3450	0.4136#
		(0.242)	(0.244)
Shiftworker Education level		0.1894	0.1921
		(0.203)	(0.204)
Adjusted R^2	.108	.126	.135
F	25.837	13.050	12.650
F significance	.000	.000	.000
N	977	835	822

** p < .01 * p < .05 # p < .10

Standard errors in parentheses. Constant not shown.

As seen in Table 2, work-life balance was strongly related to shiftworker marital satisfaction. The higher dissatisfaction was with work-life balance, as measured by our nine-item index, the greater was marital dissatisfaction.

Poor psychological health as measured by GHQ was negatively and independently related to

marital satisfaction. Sleep quality correlated with marital satisfaction, but it is also related to psychological health, which correlated more strongly with marital satisfaction. So sleep did not have a significant independent impact on marital satisfaction beyond that which it had on psychological health.

Work-risk climate and work-life imbalance also correlated with each other, as well as (negatively) with marital satisfaction. When they are added into the regression together, work-life balance dominates and safety climate appear non-significant. That is, the main way in which safety climate affects marital satisfaction is through adverse impacts on work-life balance.

Shiftworker support was strongly predictive of marital satisfaction. That is, the more support a shiftworker had, the happier they were in their relationship, when all else was held constant.

Fear of being sacked appeared to reduce marital satisfaction amongst shiftworkers, though the relationship was only weakly significant once psychological health was held constant. Fear of being sacked correlated ($r=.20$) with psychological health, so it is likely that at least some of the impact it has on marital satisfaction is through adversely affecting psychological health.

Consistent with other research, being older and having children both reduced marital satisfaction. Age significantly uniquely predict marital satisfaction in equations which also included the presence of children at home (though not always those without it). The presence of children was a stronger predictor and it independently and negatively predicted marital satisfaction without age being entered into the equation. In one equation, shiftworker

earnings weakly predicted shiftworker marital satisfaction. This was to be the only equation in which wages appeared even weakly significant.

It is noteworthy that support and work-life imbalance are only slightly weakened as unique predictors by the addition of psychological adjustment. Their effect on marital satisfaction is independent on any relationship they have with psychological adjustment

Cross-over effects from shiftworkers to partners.

Table 3 Secondary crossover regressions predicting partner marital satisfaction with shiftworker variables

Equation no:	(4.1)	(4.2)	(4.3)
Chance of being sacked	-0.1856#	-0.1967#	-0.2120*
	(0.094)	(0.102)	(0.105)
Shiftworker Support		0.4437*	0.4467*
		(0.217)	(0.221)
Work risk climate	-0.4656*	-0.4122#	-0.3747
	(0.233)	(0.244)	(0.251)
Work-life imbalance	-0.4057#	-0.4268#	-0.4224
	(0.244)	(0.257)	(0.262)
Shiftworker Sleep disturbance	0.1995	0.6014	0.6660
	(0.379)	(0.400)	(0.412)
Shiftworker Morningness		0.4674*	0.4612*
		(0.214)	(0.215)
Shiftworker Psychological ill health			-0.0384
			(0.099)
Shiftworker Age	-0.0552*	-0.0705**	-0.0742**
	(0.022)	(0.023)	(0.023)
Presence of children	-0.9005*	-1.2507**	-1.3152**
	(0.437)	(0.451)	(0.457)
Shiftworker Wage ($'000)	-0.3680	-0.4059	-0.3816
	(0.260)	(0.261)	(0.265)
Shiftworker Education level	-0.1700	-0.1602	-0.1380
		(0.229)	
	(0.218)		(0.232)
Adjusted R^2	.034	.052	.053
F	4.107	4.534	4.168
F significance	.000	.000	.000
N	707	638	626

** p < .01 * p < .05 # p < .10

Standard errors in parentheses. Constant not shown.

Table 3 shows the same variables, from the shiftworker questionnaire, regressed onto partner marital satisfaction. So it explores secondary crossover effects from work along with some non-work crossovers and demographics. As expected, partner marital satisfaction was less well explained by shiftworker variables than was shiftworker marital satisfaction, so some

variables discussed above lose significance. The r^2 of the models is less than half of that of the direct effects of shift worker work variables on shift workers themselves.

Unlike the shift worker regressions, in these models shift worker risk climate held a clearly negative impact on partner marital satisfaction. The more danger shiftworkers perceived from various aspects of work, the less satisfied partners were with their marriage.

Support felt by shiftworkers was strongly predictive of marital satisfaction amongst partners as well as amongst spouses. That is, the more support a shiftworker had, the happier they were in their relationship, when all else was held constant. Shiftworker's self-perceived work-life balance was weakly related to marital satisfaction, and this became non-significant in the final equation, which included shiftworker psychological health (though the latter was itself non-significant as an independent explanator). The shiftworker's perceived likelihood of being sacked oscillated between weak significance and acceptable significance levels, suggesting another possible mechanism for cross-over from shiftworker to partner, though more research would be needed to be conclusive.

Amongst the non-work crossovers, shiftworker morningness was a significant predictor of partner marital satisfaction in the equations, despite not predicting shiftworker marital satisfaction itself. Perhaps the moods of non-'morning' types bother their partners more than they bother the shiftworker themselves. We are hesitant to over-interpret this result, as the relationship between shiftworker morningness and partner marital satisfaction is more significant than the relationship of satisfaction with synchronicity, and it is *not* significant in bivariate data – but on the other hand it has been previously identified as a predictor of marital life satisfaction (e.g. Jankowski, 2012).

Shiftworker sleep disturbance did not independently affect or moderate the impact of the work variables on partner marital satisfaction (with or without morningness in the equations).

Presence of children was as significant in negatively predicting partner marital satisfaction as it was for their spouses. Age of shiftworker did more to predict partner marital satisfaction than to predict shiftworker marital satisfaction.

Direct and primary crossover effects on partner marital satisfaction

Table 4 Regressions predicting partner marital satisfaction with partner variables

Equation no:	(5.1)	(5.2)
Support from friends	0.9648**	0.9638**
	(0.224)	(0.244)
Partner's own work life imbalance		-0.0523
		(0.237)
Partner Att. to shiftworker work life imbalance	-1.0402**	-1.0507**
	(0.232)	(0.249)
Partner sleep disturbance	-0.2934**	-0.2227*
	(0.095)	(0.108)
Partner Morningness		-0.1130
		(0.230)
Partner Psychological ill health		-0.1713*
		(0.080)
Partner Age	-0.0911**	-0.0735**
	(0.022)	(0.024)
Presence of children	-1.1233*	-1.1472*
	(0.443)	(0.465)
Partner Wage ($'000)	0.1566	-0.1796
	(0.297)	(0.336)
Partner Education level	-0.0369	0.1869
	(0.199)	(0.214)
Adjusted R^2	.147	.159
	16.248	11.245
	.000	.000
N	617	540

** p < .01 * p < .05 # p < .10

Standard errors in parentheses. Constant not shown.

The difference between the two instruments means that it was not possible to construct mirror models, regressing partner variables on partner and shift worker marital satisfaction in an identical manner to that attempted above. For example, no factor exploring the partner's support at work was extracted due to a lack of items in the partner instrument. There were a larger number of variables to consider for inclusion in the partner regressions, due to the lack of scales measuring partner support for the shift workers'job and partner perception of shift worker's work-life balance. To simplify the model, those variables that in bivariate analysis and subsequent multivariate analyses showed little or no independent relationship with partner MSAT were again eliminated.

Table 4 presents the equations for these direct variables, measured in the partner questionnaire, along with some primary crossover variables, many of which relate in one way or another to their spouse's – the shiftworker's – job, also measured in the partner questionnaire. Amongst the four tables (2 to 5), it is these 'partner-measured' variables predicting partner marital satisfaction that give the best explanation of variance.

The strongest negative predictor of partner marital satisfaction was the main work-related primary crossover variable: the partner's dissatisfaction with their spouse's (that is, the shiftworker's) work-life interactions. If they do not like the impact the spouse's job has on the household, they are less happy with the relationship. Remarkably, this impact of their spouse's work-life interactions on partner marital satisfaction is much greater than the impact of partners' own work-life balance on partner marital satisfaction.

Almost as strong as that is a direct variable, partner support networks. Where partners perceive a lack of social support or networks, they also report lower marital satisfaction.

Partner's own sleep quality also is positively related to marital satisfaction. Partner's own psychological maladjustment has a strong negative impact on marital satisfaction. These correlate with each other, so each reduces but does not remove the significance of the other. However, the partner's own morningness does not predict marital satisfaction, even though their spouse's morningness appears to predict it in Table 3.

Secondary crossover effects from partners to shiftworkers

Table 5 Secondary crossover regressions predicting shiftworker marital satisfaction with partner variables

Equation no:	(6.1)	(6.2)
Partner Support from friends	0.7496**	0.5538*
	(0.238)	(0.262)
Partner's own work life imbalance	-0.2137	-0.2514
	(0.246)	(0.256)
Partner Att. to shiftworker work life imbalance		-0.7542**
		(0.267)
Partner sleep disturbance	-0.1190	-0.0936
	(0.106)	(0.113)
Partner Morningness	-0.0784	-0.1236
	(0.243)	(0.249)
Partner Psychological ill health		23.5387
		(86.25)
Partner Age	-0.0574*	-0.0550*
	(0.025)	(0.026)
Presence of children	-1.3541**	-1.1175*
	(0.481)	(0.500)
Partner Wage ($'000)	-0.0407	-0.0950
	(0.353)	(0.361)
Partner Education level	0.3958#	0.4917*
	(0.223)	(0.232)
Adjusted R^2	.044	.062
	4.156	4.384
	.000	.000

N	548	513

** p < .01 * p < .05 # p < .10

Standard errors in parentheses. Constant not shown.

Turning to secondary crossover effects of partner variables onto shiftworkers, Table 5 shows that the partner's own work-life imbalance does not significantly predict shiftworker marital satisfaction, but the partner's perception of the shiftworker's work-life imbalance is very significant when entered into the equation. Not only is it the case, as we saw in Table 4, that if the partner does not like the impact the spouse's job has on the household, they are less happy with the relationship, this also flows through into marital dissatisfaction by the shiftworker spouse. Of all the cross-over variables affecting shiftworker's marital satisfaction, the strongest is what we might call a double crossover effect: the shiftworkers job leads to greater partner dissatisfaction with the shiftworker's work-life balance, and this partner dissatisfaction with the shiftworker's work-life balance then leads to greater marital dissatisfaction by the shiftworker.

A partner-driven crossover effect is the support the partner received from friends, which also affected the shiftworker's marital satisfaction. In the mining towns in which research was conducted, some partners' own social lives appeared affected by the location or schedule their spouse's job, so it appears likely that some of these effects are flowing back to shiftworkers.

Again, age and presence of children negatively affect marital satisfaction. The age of the partner appeared to have a stronger impact on partner satisfaction than shiftworker satisfaction (Tables 4 and 5). Combined with earlier data (Tables 2 and 3), this suggests that

partners are more susceptible to age effects than shiftworkers themselves, perhaps reflecting a selection bias (where shiftworkers feel too old to keep up shiftwork, they are more likely to quit, but these decisions to quit take less account of the partner's age).

No other partner variables independently crossed over to shiftworkers marital satisfaction. It was the partner's perception of the shiftworker's work-life imbalance that stood out as an influence on shiftworker marital happiness.

Discussion and conclusion

It is reasonable to take as important something that affects marital satisfaction for either the shiftworker or their partner – after all, if one party is unhappy, it does not help much that the other is happy. Given that, it appears that work factors may offer a surprisingly powerful additional set of predictors of marital satisfaction, including 'spill over' effects observed in the literature as well as some 'cross over' effects. We see the operation both of primary crossover effects (where the partner's perception of the shiftworker's job affects their own marital satisfaction) and secondary crossover effects (where aspects of the shiftworker's attitudes or behavior, measured in the shiftworker survey, influence partner marital satisfaction in the partner survey). Of particular note is the 'double crossover' effect whereby the shiftworker's job leads to greater partner dissatisfaction with the shiftworker's work-life balance, and this partner dissatisfaction with the shiftworker's work-life balance then leads to greater marital dissatisfaction by both the partner and the shiftworker.

Turning to the specifics, a number of findings stand out. First, work-life interference influences marital dissatisfaction, in particular dissatisfaction is affected by interference caused through shiftworkers' own working arrangements. Negative views on the part of the

partner to their spouse's work-life interface have significant negative implications for partner marital satisfaction. This is more important than partner perceptions about the partner's own work-life balance or, seemingly, the shiftworker perceptions about their own work-life balance. Perhaps this is because, for shiftworkers more than for partners, work is their lives, and incursions from work to life are a normal part of that, whereas for the partner these incursions of their spouse's work into their time are a source of dissatisfaction directed at their spouse. This is not to suggest that, across our datasets, partners are more dissatisfied than shiftworkers with work-life balance issues – generally, this was not the case – but it was the case that marital satisfaction was lower amongst partners than amongst shiftworkers. Still, lower marital satisfaction is, as noted, often recorded amongst women than men (Kogan et al., 2013) so we cannot assert from the above that the differential in this survey is due to the effects of work.

Second, cross over of worker factors onto partner marital satisfaction was substantial, both through secondary cross over of spousal work variables onto partners, and through partner perceptions of shiftworker jobs (primary crossover). Even shiftworkers' morningness (consistent with e.g. Jankowski, 2012) appeared to have implications for partner marital satisfaction independently of other variables – indeed, moreso than for shiftworker marital satisfaction.

Third, social support is important, both directly and with crossover effects. Shiftworkers and partners who feel a lack of social support have both lower marital satisfaction, and where shiftworkers feel a lack of support this also adversely affects partners' marital satisfaction.

Fourth, psychological health is related to marital satisfaction, but without strong crossover effects. That is, shiftworker psychological health is related to shiftworker marital

satisfaction, and partner psychological health is related to partner marital satisfaction. Yet in light of our comments about some crossover effects, we might also expect that health would also have some crossover effects (e.g. one party's poor psychological health prevents them from doing some things that would otherwise enhance marital satisfaction of the other party, or directly causes tension with the other party), but no such effects are observed. This raises the possibility – which we do not answer here – that poor psychological health results from, possibly as much as causes, marital dissatisfaction. This is an issue for further research.

As Gottman and Krokoff (1989) point out, what explains current marital satisfaction may be quite a different set of variables to what predicts future marital satisfaction, and a number of prominent scholars in the field have continued to call for the need for large-scale longitudinal support, particularly in the area of sociocultural contexts (notably Bradbury et al., 2000). The ACES project addresses these aims. This study used a recognized scale of marital satisfaction and a comprehensive suite of work and other instruments and single item measures to explore marital satisfaction in the context of matched pairs, where one of the partners is working in the shiftwork-dominated mining and energy industry. It represents one of the largest studies of its kind. Magnitude of effects in marital satisfaction/longevity studies tend in most studies to be relatively low (Twenge, Campbell and Foster, 2003; Keizer and Schenk, 2012) however, this study does show that work-related variables may explain significant proportions of variability in both the martial satisfaction of shiftworkers and their partners. Future longitudinal analysis will enable the same set of variables to be examined in relation to relationship longevity, as well as enable causal links to be further explored.

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APPENDIX - Variable descriptives

	Minimum	Maximum	Mean	Std. Deviation
Marital satisfaction, member	7.00	43.00	30.06	5.55
Marital satisfaction, partner	9.00	42.00	29.48	5.52
Chance of being sacked	0.00	11.00	2.23	2.21
Shiftworker_support_	-3.69	1.45	-0.04	1.02
Work risk climate_	-1.73	2.97	0.03	1.01
Shiftworker_work_life_imbalance	-2.50	2.36	0.09	1.00
Shiftworker sleep disturbance	1.00	5.00	2.83	0.66
Shiftworker Morningness	-2.48	1.96	-0.03	0.99
Shiftworker Psychological ill-health (GHQ)	0.00	12.00	1.30	2.44
Shiftworker age,	20.00	75.00	48.74	10.28
Presence of children at home	0.00	1.00	0.47	0.50
Weekly wage Shiftworker ($'000)	0.200	16.112	2.330	0.754
Shiftworker highest level of education	1.00	5.00	3.21	0.91
Partner Social Support	-3.37	1.67	0.02	0.99
Partner's own work-life balance	-1.75	2.46	0.00	1.00
Partner's attitude to shiftworker work-life imbalance	-1.89	2.21	0.03	0.98
Partner sleep disturbance	3.00	15.00	8.53	2.28
Partner Morningness	-2.46	2.11	0.02	0.98
Partner Psychological ill-health (GHQ)	0.00	12.00	1.61	2.84
Partner Age	21.00	72.00	46.64	10.19
Weekly wage partner ($'000)	0.024	10.000	0.795	0.666
Partner highest level of education	0.00	6.00	2.57	1.08